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STRAITS SETTLEMENTS

Vol. IX 31st March, 1938 Part 4

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Vol. IX 31st March, 1938 Part 4

NOTES ON MALAYAN DIPTEROCARPACEÆ—IV*

By C. F. SYMINGTON,
Forest Research Institute, Kepong

This paper deals with rather a motley collection of species. In the first place I have tackled certain problems that have arisen in the course of preliminary botanical study in anticipation of wood-technological work on *Dipterocarpus* and *Hopea* from the Malay Peninsula. Thanks to the good work of Dr. van Slooten, the botany of *Dipterocarpus* is in reasonably good order, and with the notes here supplied on *D. gracilis* Bl. and *D. chartaceus* Sym. there is not much more essential critical work to be done on our species at this stage. With *Hopea* we are less fortunate. In this paper I have tackled one of the major problems connected with *H. Pierrei* and other species in the section *Dryobalanoides*, but there is yet much to be done in this rather difficult section of the genus.

Next I have given a note on the *Richetia* group of *Shorea*, the object of which is to bring together a group of species of obvious natural affinity. This involves the transfer of several species of *Balanocarpus* to *Shorea*, with concommitant name changes. I regret the necessity for these changes, but it *is* a necessity, and my apologies should rather be for not having made the changes sooner.

A problem that is becoming more evident and pressing with increasing knowledge is that of the delimitation of specific and lesser groups. If, for example, we consider only the species occurring on the west side of the Malay Peninsula, we find the specific limits are on the whole clearly defined, and the variations within a species are insufficiently constant to suggest the presence of definable sub-species, varieties, or other forms. Were we to extend our investigation to the whole of the Malay Peninsula,

* For previous papers see *Gard. Bull. S.S.* Vol. VII, pp. 129–159 (1933) and Vol. VIII, pp. 1–40 (1934) and 265–292 (1935).

things would not be quite so simple and, were the whole possible range of distribution of our dipterocarps considered, the delimitation of species would become a very acute problem. For example, there are several dipterocarps in Brunei that, on the usual morphological evidence, are clearly much more closely related to certain Malay Peninsula species than to any other described forms. Yet in some character or characters, possibly vegetative ones usually considered of little importance, they do differ distinctly and constantly. Should these Brunei trees be considered as species distinct from their Malay Peninsula counterparts; as varieties, forms, or some lesser groups; or are the differences so slight as to be unworthy of definition? These are obviously questions which can be adequately answered only in the light of very extensive knowledge of concepts and variations of groups within the family; premature decisions are likely to necessitate undesirable alterations in the future. Some problems with practical issues involved, however, cannot be postponed indefinitely, and one such problem, concerning *Shorea assamica*, is tackled in this paper.

The problem of specific definition arises again in this paper in connection with *Parashorea malaanonan* and its variety here described as var. *tomentella*. *P. malaanonan* introduces another matter of general interest, conveniently described as "the treatment of doubtful interpretations". For example, I am faced with deciding whether or not to accept Merrill's interpretation of Blanco's *Mocanera malaanonan*. I do not consider Merrill was justified in his interpretation, but the evidence is insufficient to prove him wrong. In the circumstances, and because the name *Parashorea malaanonan* is now well established in botanical and forestry literature, it seems desirable to accept Merrill's interpretation. But the position cannot be considered satisfactory, and it seems appropriate here to plead with those who undertake interpretations of this nature to treat the names as *nomina dubia* or *nomina ambigua* unless the evidence is incontrovertible.

The description of new species from Borneo, commenced in the last paper of this series, is continued here, the following species being described and figured—*Shorea acuminatissima*, *S. xanthophylla*, *S. sandakanensis*, and *S. Smithiana*.

The paper is concluded with a description of *Vatica diospyroides* (one of several interesting new dipterocarps from Dr. Kerr's Siamese collections) and a note on two dipterocarps collected by the Oxford University Exploration Club in Borneo but omitted from the collection submitted to me in 1934 (*vide Gard. Bull. S.S.* 8 : 1).

I should like to thank the many botanists and forest officers who have continued to give me their valued assistance and co-operation. I am also indebted to the Director of the Bureau of Science, Manila who afforded me the opportunity of studying

the Philippine collections of dipterocarps during a visit to Manila in December 1935, and to the Director of the Royal Botanic Gardens, Kew who again extended to me the hospitality of the Herbarium during my leave in 1936.

Dipterocarpus gracilis Bl., Bijdr. V, 224 (1825); V.Sl. in Bull. Jard. Bot. Buitenz. III, 8 : 276 (1927). *D. pilosus* Roxb. (1832) sensu Parker in Ind. For. Rec. 13 : 15 (1927), non sensu Brandis in Journ. Linn. Soc. (Bot.) 31 : 28 (1895). *D. vernicifluus* Blanco, Fl. Philip. ed. 2, 314 (1845). *D. Skinneri* King in Journ. As. Soc. Beng. 62, pt. 2 : 91 (1893); Ridl., Fl. Mal. Penins. 1 : 214 (1922); V. Sl. in l.c. 294; Foxw., Mal. For. Rec. 10 : 70 (1932) var. hirtus Ridl. excl.. *D. angustialatus* Heim in Bot. Tidsskr. 25 : 43 (1903); Fischer in Kew Bull. 1926 : 457.

In my endeavour to decide upon the correct name for the tree we have known in the Malay Peninsula as *Dipterocarpus Skinneri* I find it impossible to distinguish our tree from that known in Burma, the Andamans, and Siam, as *D. pilosus,* and from the tree known as *D. gracilis* in the Netherlands Indies and the Philippines.* *D. pilosus* has been considered systematically by Parker and *D. gracilis* by van Slooten, both in 1927. These authors were working simultaneously on different territorial regions and neither has indicated that union of the two species might be necessary, although Parker united *D. Skinneri* King with his *D. pilosus,* and van Slooten drew attention to the similarity of *D. Skinneri* King and *D. gracilis* Bl. Moreover, prior to publication of Parker's work, the identity of *D. pilosus* Roxb. was, as van Slooten (l.c., p. 274) rightly points out, entirely problematical, although Brandis and some other authors considered it to be identical with *D. Baudii* Korth. Parker's interpretation of Roxburgh's *D. pilosus* is based on field investigation and a process of elimination. His arguments are very reasonable, but one cannot overlook the fact that the plant he calls *D. pilosus* does not entirely fit Roxburgh's, admittedly brief and inadequate, description. I should prefer to consider Roxburgh's *D. pilosus* as a *nomen dubium,* but as I am solely concerned at present with finding a name for the Malay Peninsula tree formerly known as *D. Skinneri,* a decision on this point is immaterial. I am satisfied that our tree is specifically identical with Parker's *D. pilosus* and with *D. gracilis* Bl. as interpreted by van Slooten. Blume's name has precedence, even if *D. pilosus* sensu Parker is *D. pilosus* Roxb., because Roxburgh's name was not validly published until 1832, seven years after *D. gracilis* Bl.

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* *D. vernicifluus* Blanco is the more common name in Philippine literature, but this species was united with *D. gracilis* Bl. by van Slooten in 1927.

Dipterocarpus chartaceus Sym. **nom. nov.** *D. Skinneri* var. *hirtus* Ridl., Fl. Mal. Penins. 1 : 215 (1922); V.Sl. in Bull. Jard. Bot. Buitenz. III, 8 : 295 (in nota sub D. Skinneri). *D. Skinneri* sensu Ridl., op. cit. 214 quoad Curtis 3734; sensu Foxw., Mal. For. Rec. 10 : 70 (1932) partim; non D. Skinneri King.

Ridly first drew attention to this species when he segregated from his specimens of *D. Skinneri* a collection from Pahang (C.F. 3195), describing it as *D. Skinneri* var. *hirtus*. He failed, however, to recognize Curtis 3734 from Province Wellesley as the same form, citing it under *D. Skinneri*. In 1927 van Slooten drew attention to the fact that these two specimens were identical, and expressed the opinion that they should not be considered as a form of *D. Skinneri* King but as a distinct species. But in 1932 Foxworthy took the view that *D. Skinneri* was a variable species and included both the typical form and Ridly's var. *hirtus* under the one name.

I am returning to van Slooten's conception of Ridley's *D. Skinneri* var. *hirtus*, considering it worthy of specific rank. This species is undoubtedly very closely related to *D. Skinneri* King (= *D. gracilis* Bl.), but in several respects it is quite distict. The fruit wings in *D. chartaceus* are relatively broader and more distinctly 3-nerved than in *D. gracilis*, the fruit lobes are much smaller, the leaf is broader and has fewer nerves, and the texture of the leaves and twigs is distinct. In *D. chartaceus* the hairs are longer, sparse and deciduous, the mature leaf being almost glabrous, shining on both surfaces, and of a brittle papery texture : in *D. gracilis* the undersurface of the leaf is covered with stellate hairs usually forming a close tomentum.

As the name *Dipterocarpus hirtus* has already been employed I am renaming this species *D. chartaceus;* a name descriptive of the peculiar leaf texture.

Collections examined :—

PENINSULAR SIAM : For Dept. Siam *s.n.* (10.5.20). Kerr 12245, 14324, 15693, 18250.

MALAY PENINSULA :

PERLIS : C.F. 40828.

PROVINCE WELLESLEY : Curtis 3734.

KELANTAN : C.F. 29028.

PAHANG : C.F. 3195 (Auth. spec. of *D. Skinneri* var. *hirtus* Ridl.), 6650, 15645, 24546, 29601, 40416, 40683, 40686, 40705.

NEGRI SEMBILAN : C.F. 24352.

JOHORE : C.F. 17089 (?)

A form of *keruing*, widely distributed in the Peninsula although not abundant, has been known by the name of *D. Skinneri*. The opinion is here expressed that this is the

Plate 17. *Hopea Pierrei* Hance.

same species as that known by the name of *D. pilosus* in Burma and *D. gracilis* in the Netherlands Indies and the Philippines. The species are united and the oldest name *D. gracilis* Bl. is adopted in place of our *D. Skinneri.*

Another rather rare form of *keruing* was described by Ridley in 1922 as *D. Skinneri* var. *hirtus.* It is considered that this variety is worthy of specific rank and it is renamed *Dipterocarpus chartaceus* Sym.

Hopea Pierrei Hance in (Lond.) Journ. Bot. 15: 308 (1876) et 329 (1877); Brandis in Journ. Linn. Soc. (Bot.) 31 : 67 (1893) Pl. 2, fig. 10, quoad speciminum cambodiorum; Dakkus in Bull. Jard. Bot. Buitenz. 3, Suppl. 1 : 162 (1930); non Hopea Pierrei sensu Ridl., Fl. Mal. Penins. 1 : 238 (1922); non sensu Foxw., Mal. For. Rec. 10 : 133 (1932); non sensu auct. philip. (1909–1937). "*Hopea micrantha*?" Hance in l.c. : 242, non H. micrantha Hook. f.. *Hancea Pierrei* Pierre, Fl. For. Cochinch. 16 (1891) t. 248 (in tabula antem Hopea Pierrei). **Plate 17.**

Pierre's description and drawing of *Hopea Pierrei* are excellent, while his remarks concerning the diagnostic characters separating it from *Hopea Griffithii* Kurz, *H. micrantha* Hook. f., *H. Beccariana* Burck, and *H. microptera* Dyer (= *H. Dyeri* Heim) bear evidence of careful study, and should have been sufficient to obviate the mistakes of subsequent authors. The tree, as I know it from the Malay Peninsula, agrees entirely with Pierre's description except that I have not noted any marked development of adventitious stilt roots. This, however, is a variable character in the section *Dryobalanoides.* The most useful diagnostic characters are the short petiole, the midrib sunk on the upper surface, the numerous but faint main nerves, the bottle-shaped ovary and stylopodium, and the glandular outer sepals. The presence of domatia in the axils of the lower nerves is variable.

This species was first discovered in the island of Phu Quoc in Cambodia and tentatively identified by Hance in 1776 with *Hopea micrantha* Hook. f. Shortly afterwards, however, he named the species *Hopea Pierrei.* In 1891 Pierre described and figured the species (under *Hancea*) in considerable detail, basing his observations on specimens numbered 1425 in his herbarium which are, presumably, those examined by Hance.

Subsequent misinterpretation of Hance's species has resulted in *Hopea Pierrei* being recorded from Borneo, the Philippine Islands, and the Malay Peninsula, on false evidence. In 1895 Brandis added Borneo and Singapore to the distribution of the species on the evidence of Becc. 2504 and 3050 from Borneo, and a collection of Ridley's from Singapore. A consideration of leaf characters alone makes it quite clear that Beccari's

collections are not *H. Pierrei* Hance. In that species the midrib is depressed above but in the Bornean collections it is distinctly raised. I consider that the latter are *H. Dyeri* Heim. I am not sure to what specimen of Ridley's Brandis refers when recording *H. Pierrei* from Singapore, but in all probability it was one of the two Kew sheets of *H. Griffithii* Kurz from that locality.

In 1922 Ridley continued to record *H. Pierrei* from the Malay Peninsula but his citations appear (it is difficult to identify the specimens with certainty as no numbers are cited) to include four distinct species none of which is *H. Pierrei* Hance. Quite erroneously he gives *H. intermedia* King as a synonym of *H. Pierrei* Hance.

Foxworthy, who continued to record *H. Pierrei* from the Peninsula, had a different conception of the species from either Brandis or Ridley. The specimens he cites are, with the exception of King 3525 and Holmberg 820 (which may be *H. Dyeri* Heim), all *H. pedicellata* (Brandis) Sym. (*see* p. 327).

Hopea Pierrei Hance, however, does occur in the Peninsula, although Brandis, Ridley, and Foxworthy have all recorded it as a result of mistaken identification. The earliest collection from the Peninsula was a sterile specimen (C.F. 3950) from Bentong District of Pahang collected in 1919. It is represented only in the Kepong herbarium and until now has been unidentified. Since 1930 several additional collections have been made by the Forest Department, at Bukit Raka in Bentong District of Pahang and at Ulu Gombak in Selangor. Unfortunately only one of these has flowers, but comparison of this with Pierre's specimen shows that it has all the distinctive vegetative and floral characters of *H. Pierrei* Hance.

I have already stated that I consider Brandis wrong in recording *H. Pierrei* Hance from Borneo. The species has also been recorded from the Philippine Islands, from 1909 onwards, as a result of mistaken identification. I shall not here attempt to unravel the confusion under the name of *H. Pierrei* in the Philippine literature but, having examined, as far as I know, all the material concerned, I can say definitely that none is *H. Pierrei* Hance. Actually I think seven different species have, from time to time, been included under the one name. Among these are specimens of *H. malibato* Foxw. and *H. Foxworthyi* Elmer (Syn. = *H. glutinosa* Elmer), but the remainder are probably undescribed.

Hopea Pierrei is found in cultivation in the Botanic Gardens, Buitenzorg.

Collections examined :—

CAMBODIA: Pierre 1425 (Auth. spec. of *Hopea Pierrei* Hance); Guibier No. 2; Foxworthy No. 8.

SIAM : Chantaburi; Kerr 9176: N. Rabil 14.

Plate 18. *Hopea Beccariana* Burck.

MALAY PENINSULA:
PAHANG: C.F. 3950, 38023, 38035.
SELANGOR: C.F. 23645, 36632, 37292, 37296, 37297.
JAVA: (Cult.) Hort. Bog. VII—B—58.

Hopea Pierrei Hance is a form of *merawan* which was described originally from Cambodia. Brandis, Ridley, and Foxworthy, have recorded this species from the Malay Peninsula, but investigation shows that they have applied the name *Hopea Pierrei* to the wrong trees. It is here shown, however, that true *Hopea Pierrei* does occur in the Peninsula, although its known distribution is limited to two localities, Bukit Raka near Bentong and Ulu Gombak in Selangor.

Hopea Beccariana Burck in Ann. Jard. Bot. Buitenz. 6: 240 (1887); Brandis in Journ. Linn. Soc. (Bot.) 31: 68 (1895); Sym. in Gard. Bull. 8: 28 (1934) in obs. *Hancea Beccariana* Pierre, Fl. For. Cochinch., t. 248 (1891) in nota sub H. Pierrei. *Hopea Nicholsoni* Heim in Bull. Soc. Linn. Paris, 2: 293 (1891). *Hopea intermedia* King in Journ. Asiat. Soc. Beng. 62: 126 (1893) et in Ann. Bot. Gard. Calcutta 5, pt. 2: 156, Pl. 189A (1896) pro maiore parte; Brandis in l.c. 67, partim; Foxw., Mal. For. Rec. 10: 134 (1932); Durant, Rep. Forests Brunei; 40 (1932); Burkill, Dict. Econ. Prod. Mal. Penins.: 1190 (1935); non H. intermedia sensu Foxw., Mal. For. Rec. 3: 74 with 2 plates (1927). *Balanocarpus ovalifolius* Ridl. in Journ. F.M.S. Mus. 10: 130 (1920) pro maiore parte; non B. ovalifolius sensu Foxw., Mal. For. Rec. 10: 143 (1932). *Hopea Pierrei* sensu Ridl., Flor. Mal. Penin. 1: 238 (1922) partim, non H. Pierrei Hance et sensu auct. **Plate 18.**

This species is adequately described under *H. intermedia* by Foxworthy (*Mal. For. Rec.* 10: 134). I would comment, however, that the stamens are definitely 15 in number and that a stilt-root habit does frequently develop in old trees. As remarked by many authors this species is similar to *H. Pierrei* Hance in flower structure. *H. Pierrei,* however, differs markedly in having glandular sepals, in the shorter petiole, and in the midrib of the leaf which is sunk above as opposed to raised in *H. Beccariana.*

Hopea Beccariana was founded by Burck on one of Beccari's Bornean collections (1177) which has leaves and immature fruits. Four years later Heim described an almost identical Beccarian collection (2761) as *H. Nicholsoni.*

A tree which I consider to be the same species was collected on Penang Island by Curtis, and described by King in 1893 as *H. intermedia.* King cited three collections when describing the species—Curtis 425 and 1398, and Kunstler 3709 (Perak). The last is certainly another species and its citation here may

have been partly responsible for subsequent confusion. However, from the excellent figure published by King in the *Ann. Bot. Gard. Calcutta,* there can be no doubt which species King had in mind as *H. intermedia.*

Brandis followed King but made some original suggestions as to the affinities of the species. He suggested that *H. intermedia* might be established as con-specific with *H. Pierrei* Hance, a suggestion upon which Ridley acted in 1922 when he united the two species. Brandis was certainly correct in drawing attention to the similarity in floral anatomy, but vegetatively these species are so distinct that there can be little justification for the union. Brandis also erroneously cited Curtis 1397 under *H. intermedia:* it is *H. pedicellata* Sym. (*see* p. 327).

Ridley's conception of *H. Pierrei* is very confused. His citations include, besides several collections of *H. Beccariana,* those of at least two other species none of which is *H. Pierrei* Hance. (Ridley has also cited some collections of *H. Beccariana* under *H. micrantha*). In 1920 Ridley described *Balanocarpus ovalifolius* from a flowering collection of *H. Beccariana* (Haniff 3727). He cited also Curtis 426, which had tentatively been placed under *Balanocarpus latifolius* by Brandis, but this is actually a sterile collection of seedling leaves of *Shorea Maxwelliana* King. Ridley's *B. ovalifolius* has since been misinterpreted by Foxworthy.

It is clear from the Plates in *Mal. For. Rec.* 3 that in 1927 Foxworthy's conception of *H. intermedia* was not that of King but in 1932 this misconception was corrected, although a few wrongly determined collections have been included in the specimens cited.

We now have ample flowering and fruiting material of *H. Beccariana* from the Malay Peninsula, but from Borneo, the type locality, only Beccari's original specimens with young fruits and some recent sterile collections exist as far as I know. It may, therefore, seem somewhat rash to unite *H. intermedia* King (the Peninsula form) with *H. Beccariana* Burck, but the vegetative characters of this tree, in particular the long petiole, make it distinct from most related forms. Moreover we have additional support for the union in field and wood characters.

Collections examined :—

MALAY PENINSULA : PENANG : Curtis 425,* 1938 (Auth. specs. of *H. intermedia* King), s.n.; S'pore 3460, 3474, 3721, 3727 (Auth. spec. of *B. ovalifolius* Ridl.), 9140; C.F. 2552, 8149, 9661, 10802, 11218, 11673, 11678, 11731, 27783, 28029, 28051.

KEDAH : C.F. 8906, 11467, 17776, 21920.

* There has been some confusion in the labelling of some of the sheets in the Singapore Herbarium : there are four sheets of *H. Beccariana* and two of *H. pedicellata* all labelled Curtis 425.

Plate 19. *Hopea pedicellata* (Brandis) Sym.

KELANTAN : C.F. 37811.
PERAK : Ridl. s.n. (Feb. 1891), C.F. 3413, 11040, 14384, 14387, 17066, 27822, 28594, 31075.
DINDINGS : C.F. 5001, 5007, 9857, 16574, 16599, 27844.
SELANGOR : C.F. 30148, 32854, 37290, 40762, 40970.
PAHANG : C.F. 8149, 27971, 37319, 42932.
NEGERI SEMBILAN : C.F. 23670, 24292, 26636, 43543.
MALACCA : Goodenough 1447; C.F. 41552.
JOHORE : C.F. 1199, 5852, 5863.

BORNEO : SARAWAK : Becc. 1177 (Auth. spec. of *H. Beccariana* Burck) and 2761 (Auth. spec. of *H. Nicholsoni* Heim).
BRUNEI : C.F. 28662, 30611, 37052, 37121.
BRITISH NORTH BORNEO : Villamil 38 (?)

Hopea Beccariana, the *merawan batu* of our *List of Botanical and Vernacular Equivalents*, is a common tree on ridges in hilly jungle on Penang Island, the Dindings, and elsewhere throughout the Malay Peninsula. It has coarsely fissured bark, a tendency to become stilted, and frequently produces prolific regeneration. The identity of the tree has not been very well understood but it has usually been given as *Hopea intermedia* King. *Hopea intermedia* King is here considered to be conspecific with *H. Beccariana* Burck described from Borneo and the latter name is adopted for our *merawan batu*.

Hopea pedicellata (Brandis) Sym. **comb. nov.** *Hopea micrantha* sensu King in Journ. Asiat. Soc. Bengal 62, pt. 2 : 124 (1893) partim; sensu Ridl., Fl. Mal. Penins. 1 : 237 (1922) partim; non H. micrantha Hook. f.. *Hopea Griffithii* var. *pedicellata* Brandis in Journ. Linn. Soc. 31 : 69 (1895) specimina sumatrana exclusa; Ridl. in op. cit. 238, in nota sub H. Pierrei. *Hopea intermedia* sensu Brandis in l.c. 67 quoad Curtis 1397, non H. intermedia King. *Hopea mengarawan* sensu Brandis in l.c. 70 quoad King 8170, non H. mengarawan Miq.. *Hopea Pierrei* sensu Ridl., op. cit. 238, partim; sensu Foxw., Mal. For. Rec. 10 : 133 (1932) et ex Burkill, Dict. Econ. Prod. Mal. Penins. 1193 (1935), pro maiore parte; non H. Pierrei Hance. **Plate 19.**

As Brandis' original description of this species under *Hopea Griffithii* var. *pedicellata* is inadequate and other descriptions have been confused by the inclusion of other species, I have prepared the following—

Branchlets grey or purple-black, often conspicuously lenticellate, usually puberulous towards the ends but later glabrous. *Leaves* lanceolate or oblong-lanceolate, caudate-acuminate at the apex, rounded or acute and occasionally subcuneate at the base, usually about 6.5 × 2.5 cm. to 11.0 × 4.25 cm., glabrous on both surfaces except for the midrib which

is usually puberulous above, drying yellow-brown on both surfaces but usually paler on the upper; midrib raised on both surfaces, puberulous above, prominent and glabrous beneath; main nerves about 13 to 16 pairs, fine and parallel, inarching at the leaf margins, frequently furnished with small tufted domatia in their axils, between each are 1 to 3 slightly shorter intermediary nerves parallel to them; main and intermediary nerves faintly visible and slightly sunk on the upper surface, visible as faint yellow lines on the smooth under-surface; reticulations invisible to the naked eye; petioles 0.8 to 1.2 cm. long, sub-terete, dark and glabrescent or fulvous tomentose; stipules minute, caducous. *Panicles* axillary towards the tip of the branchlets or terminal, of solitary or paired racemes, 3.0 to 4.0 cm. long at most, glabrous or very sparsely puberulous; ultimate branchlets of raceme 5.0 to 10.0 mm. long, each bearing 3 to 5 secund flowers about 1.5 mm. apart. *Flowers* sub-ovate in bud, pedicellate, about 4.0 mm. long (including the pedicel); pedicel about 1.0 mm. long (not thickening gradually towards the sepal bases as in some related species), glabrous and drying black. *Sepals* broadly ovate, shortly blunt acuminate, glabrous on both surfaces, sparcely papillose outside. *Petals* linear-oblong, usually blunt, tomentose on the portion exposed in bud, white to creamy yellow in throat of corolla (Symington). *Stamens* normally 15 (13 and 16 have been counted), the inner row of 10 sub-equal, the outer row (epistaminous on alternate stamens of the inner row) smaller; filaments broad at the base narrowing rather abruptly about the middle to the filamentous upper portion; anthers oval, 4-celled, the anterior cells almost as large as the posterior; appendage to connective filiform, about as long as the filament and anther. *Ovary* and stylopodium broadly cylindrical, slightly constricted below the stylopodium, truncate at the top; style erect cylindrical, about as long as the stylopodium, stigma minute. *Fruit* glabrous on all parts; stalk small but conspicuous, about 1.0 mm. long; two long wing-like accrescent sepals spathulate, blunt, about 4.5 × 0.8 cm., thick and woody at the base, chartaceous on the free portions, about 7-nerved; three small sepals, rotundate, about 0.7 cm. high, rather woody; nut embraced in the lower half by the closely appressed imbricate sepals or sepal bases, ovate-conical, about 10.0 × 6.0 mm., shining, more or less covered with a thin coat of resinous cement, crowned with a short sharp apicula (persistent style).

The species here named *Hopea pedicellata* is common on the hills of Penang and in parts of Perak. It was first mentioned in botanical literature in 1893 when King referred four collections in flower (167 and 1397) and fruit (266 and 8170) to *Hopea micrantha* Hook. f., a species described from Borneo. Having examined all the relevant herbarium material I agree with Brandis in considering King's identification to be wrong. Superficially the two species are extremely alike but, as Brandis

points out, the characters of the stylopodia are distinct—in *H. micrantha* the ovary is surmounted by a cylindrical style but in *H. pedicellata* there is a thick truncated stylopodium.

Although Brandis detected the mistaken identification of King he does not appear to have had a very clear conception of the species himself; he cites one specimen (Curtis 1397) under *H. intermedia,* one (King 8170) under *H. mengarawan,* and on a third (Curtis 167) he founded his *H. Griffithii* var. *pedicellata.* The description of this variety is very brief—*"Pedicels nearly as long as calyx. Branches of inflorescence puberulous in the Sumatran specimens"*—and the citations are—Penang (Curtis 167), Sumatra (Forbes 3205, 3208). The Sumatran specimens differ so considerably from Curtis 167 both in vegetative and flower characters that I do not think they can be considered as the same species; I am restricting Brandis name, therefore, to the Penang specimen.

In describing this species as a variety of *H. Griffithii* Kurz, Brandis has evidently been mainly influenced by the similarity in stylopodium. I consider, however, that, in view of the marked differences in other characters, the two plants should be kept specifically distinct.

In 1922 Ridley referred a specimen (presumably Curtis 1397, Govt. Hill, Penang, 1200 feet altitude) of this species to *H. micrantha* Hook. f. but concerning Curtis 167, upon which Brandis' *H. Griffithii* var. *pedicellata* is founded, he says *"it is just possible that it is a hybrid between* H. Pierrei and H. micrantha".

In 1932 Foxworthy described *H. pedicellata* as *H. Pierrei** but the differences are so considerable that there seems no justification for doing so. (See also notes under *H. Pierrei*).

Collections examined :—

PENINSULAR SIAM : S'pore 24205.

MALAY PENINSULA : Penang : Curtis 167 (Auth. spec. of *H. Griffithii* Kurz var. *pedicellata* Brandis), 266, 425, 1397, 1405, s.n.; S'pore 3475, 3732, 3770, 9137; C.F. 11679, 27790, 28032.

Perak : King 8170; C.F. 25562, 25635, 25874, 28083, 28994, 28995.

Kelantan : C.F. 37667 (?)

Trengganu : C.F. 26913.

On the hills on Penang Island there are two common species of *Hopea* known as *merawan.* One is a smooth-barked tree with marked stilt roots, while the other (our *merawan batu*) has fissured bark and is not markedly stilted. There has been much confusion concerning the botanical identity of these trees. On

* King 3525 and Holmberg 820 should be excluded from the citations in *Mal. For. Rec.* 10 : 134.

pp. 325–327 the fissured-barked tree is investigated and it is shown that it should be known as *Hopea Beccariana* Burck, while in the above note it is concluded that the smooth-barked tree should be called *Hopea pedicellata* (Brandis) Sym.

The Richetia Group

I have referred in these *Notes on Malayan Dipterocarpaceæ* I and II to the very close relationship existing between certain species of *Shorea* and *Balanocarpus* and in the latter paper (p. 27) I have identified the wingless-fruited members of this group with Heim's genus *Richetia*. Similarly the winged-fruited members may be identified with Heim's section *Richetioides* of *Shorea*. There is, however, no essential difference between *Richetia* and *Richetioides* and there are species with rudimentary wings which bridge the apparent gap between them. Lumped together they form a natural group which, for convenience, I refer to as the *Richetia* group.

The Malay Peninsula species of this group have been enumerated by Desch (*Mal. For. Rec.* 12: 37) whose wood-anatomical examinations entirely support my grouping based on external morphological characters. I therefore feel that there can no longer be any justification for maintaining some members of this group in *Balanocarpus* and some in *Shorea* and am here referring all the species to *Shorea*. The name-changes involved are these—*Balanocarpus multiflorus* (Burck) Sym. in Gard. Bull. S.S. 7 : 153 (1933) becomes **Shorea multiflora** (Burck) Sym. **comb. nov.**; *Balanocarpus coriaceus* (Heim) Brandis in Journ. Linn. Soc. 31 : 112 (1895) becomes **Shorea Richetia** Sym. **nom. nov.**; *Balanocarpus pahangensis* Foxw., Mal. For. Rec. No. 10 : 145 (1932) becomes **Shorea balanocarpoides** Sym. **nom. nov.**; *Balanocarpus maximus* King in Journ. Asiat. Soc. Bengal 62 : 133 (1893) becomes **Shorea maxima** (King) Sym. **comb. nov.**; and *Balanocarpus longiflorus* (Brandis) Foxw. ex Sym. in Gard. Bull. S.S. 8 : 29 (1934) becomes **Shorea longiflora** (Brandis) Sym. **comb. nov.**

To the *Richetia* group I assign the following species—*Shorea Faguetiana* Heim, *S. hopeifolia* (Heim) Sym., *S. multiflora* (Burck) Sym., *S. balanocarpoides* Sym., *S. blumutensis* Foxw., *S. gibbosa* Brandis, *S. Richetia* Sym., *S. kalunti* Merr., *S. resina-negra* Foxw., *S. maxima* (King) Sym., and possibly *S. longiflora* (Brandis) Sym. The last three, however, are in some respects atypical. Several hitherto undescribed Bornean species, including *S. xanthophylla* Sym. and *S. acuminatissima* Sym. described in this paper, also belong to the *Richetia* group.

The diagnostic anatomical, morphological, and field characters, of the group are many, but I shall defer enumeration of them until the undescribed members have been more fully studied. One important point I should like to record here is

that all species have 2-celled anthers. Foxworthy described *S. resina-negra* as having 2-celled anthers, but I cannot find any other record of this condition in other members of the family, nor in family or generic diagnoses.

I have referred to this group of species somewhat noncomittally as the "*Richetia* Group". It will, of course, be necessary to assign to it a definite botanical rank such as genus, subgenus, section, or subsection, but I leave such assignation until a time, not too far distant I hope, when a reliable taxonomic treatment of the genus *Shorea* will be produced. Considered purely from a botanical standpoint there can be little doubt that the *Richetia* group merits generic rank, and there are other groups within the genus, *e.g.*, sections *Eushorea* Brandis and *Anthoshorea* Brandis, that could also quite legitimately be so treated. A similar condition exists in the genus *Hopea*. Let us hope, however, that if and when these genera are next monographed, full consideration will be given to the claims of those whose interest in the trees concerned is mainly from the utilization standpoint. It is alarming to contemplate the effects of a revision in nomenclature of the *Dipterocarpaceæ* under a narrow generic conception, but as this can quite conveniently be avoided by the creation of sub-genera rather than genera, it is to be hoped that this latter method of treatment will be followed.

Shorea assamica Dyer forma **assamica** Sym. **stat. nov.** *Shorea assamica* Dyer in Hook. f., Fl. Brit. Ind. 1 : 307 (1874); Brandis in Journ. Linn. Soc. 31 : 85 (1895), et Ind. Trees. 70 (1911); Foxw. in Philip. Journ. Sc. (Bot.) 4 : 516 (1909); Troup, Ind. Woods and Uses 241 (1909), et Silv. Ind. Trees 133 (1921); Gamble, Man. Ind. Timb. 83 (1922); Pearson et Brown, Commerc. Timb. Ind. 1 : 119 (1932); Parkinson in Ind. For. Rec. (Bot.) 1 : 40 (1937).

forma **philippinensis** (Brandis) Sym. **stat. nov.** *Shorea philippinensis* Brandis in l.c. (1895) 88; Foxw. in op. cit. 6 : 272 (1911) partim, et 13 : 190 (1918); Merr. Enum. Philip. Flow. Pl. 3 : 98 (1923). *"Shorea sp. aff. S. Harmandii Pierre,"* Foxw. in op. cit. 6 : 272 (1911). *Shorea pallida* Foxw. in op. cit. 13 : 190 (1908).

forma **Koordersii** (Brandis) Sym. **stat. nov.** *Vatica celebica* Koorders, Mss. in Herb. Koord. (1895). *Shorea Koordersii* Brandis ex Koorders in Meded. 'S Lands Plant. 19 : 355 (1898); Icon Bogor. 1, Tab. 80 (1901); Heyne, Nutt. Plant. Ned. Ind. edit. 1, 3 : 303 (1917) et edit. 2, 2 : 1120 (1927); Endert in Korte Meded. Bosch. 51 (Tectona 28 : 288) 1935.

forma **globifera** (Ridl.) Sym. **stat. nov.** *Shorea globifera* Ridl., Fl. Mal. Penins. 1 : 232 (1922); Foxw., Mal. For.

Rec. 3 : 35 (1927), et 10 : 191 (1932); Sym. ex Desch, Mal. For. Rec. 12 : 27 (1936). **Plate 20.**

I have here united under one specific head four "species"—*S. assamica* Dyer (from Assam), *S. philippinensis* Brandis (from the Philippines), *S. Koordersii* Brandis (from Celebes), and *S. globifera* Ridl. (from the Malay Peninsula). Having examined a considerable amount of material of each I do not think that specific differentiation of these forms is justified, but there are certain fairly constant definable minor differences such as one would expect in distinct geographical races of a widely distributed species. I have, therefore, recognized four forms—forma *assamica* (from Assam and Burma), forma *philippinensis* (from the Philippines), forma *Koordersii* (from Celebes and the Moluccas), and forma *globifera* (from the Malay Peninsula and Sumatra).

There has been comparatively little systematic confusion in this species. The form *assamica*, the first to be described, was collected in Assam and described by Dyer as *S. assamica* in 1874. This form has since been collected also in Upper and Lower Burma and Tenasserim.

The form *philippinensis* was first described from Luzon by Brandis in 1895 as *S. philippinensis*, but this form does not appear to have been very clearly understood in the Philippines. In 1911 Foxworthy cited under *S. philippinensis* several collections of other species, and he listed three authentic collections under the heading of "*Shorea sp.* aff. *S. harmandii* Pierre". These last three were made the basis of a new species, *S. pallida* Foxw., in 1918 but this was rightly reduced to *S. philippinensis* by Merrill in 1923.

The form *Koordersii* was described as *S. Koordersii* by Brandis in 1898 from collections from North Celebes. Brandis drew attention to the similarity between this and his *S. philippinensis*, and even suggested their possible specific union when more material of the latter was available.

The Malay Peninsula form, forma *globifera*, was described by Ridley from fruiting material as *S. globifera* in 1923. In 1932 Foxworthy added a description of the flowers. This form has since been collected in Sumatra by Yates.

The various forms have been fairly adequately described under the names of *S. assamica*, *S. philippinensis*, *S. Koordersii*, and *S. globifera*, but concerning Foxworthy's description of the flowers of the last-named, I would remark that I have been unable to verify the presence of more than 15 stamens, the species being typical of the section *Anthoshorea* Brandis.

In the following Key the main differences between the forms are enumerated.

Plate 20. *Shorea assamica* Dyer forma *globifera* (Ridl.) Sym.

(1) Branchlets of raceme usually simple, solitary, and alternate; stigma distinctly 3-partite; fruit wings up to about 10.0 cm. long; appendage to connective about 1½ times as long as the anther ..... forma *assamica*

(1) Branchlets of raceme frequently bi-furcate or fascicled

(2) Stigma usually distinctly 3-partite; fruit wings up to about 10.0 cm. long; appendage to connective as long as the anther .....forma *globifera*

(2) Stigma simple, flattened, or obsurely lobed; fruit wings up to about 7.0 cm. long; appendage to connective about twice as long as the anther ..... (3)

(3) Leaves usually closely peltate and smooth beneath ..... forma *Koordersii*

(3) Leaves usually sparsely soft-stellate-hairy beneath ..... forma *philippinensis*

Collections examined :—

ASSAM (forma *assamica*) : G. Mann s.n. (Auth. spec. of *S. assamica* Dyer), G. Mann *s.n.* 1883, G. Mann *s.n.* 1890; H. C. Hill *s.n.*; Hole 33; Simmons *s.n.*; A. Das 10652; U. Kanjilal 3414; For. Dept. Assam 13115 and *s.n.* 10.12.36.

BURMA (forma *assamica*) : E. M. Buchanan *s.n.*; S. M. Toppin 6019; Sukœ 2239, 7956; Parkinson 1 and 317.

MALAY PENINSULA : (forma *globifera*) : KEDAH AND LANGKAWI : C.F. 7658, 7675, 7738, 11775, 12217, 12218, 12222, 12227, 20735, 27892, 33176.

KELANTAN : C.F. 32744, 32745, 32746, 32808, 32809, 33266, 33269, 33270, 33430.

PERAK : C.F. 3072, 8308, 10369, 12983, 12985, 16349, 16706, 27226, 29866, 29894, 29924, 31038, 38103, 39070, 39071, 39223, 41613.

TRENGGANU : C.F. 24282.

PAHANG : C.F. 4027, 4052, and 5073 (Auth. specs. of *S. globifera* Ridl.); C.F. 797, 856, 20345, 29398, 29998.

SUMATRA (forma *globifera*) : Yates 1264, 1675.

PHILIPPINE ISLANDS (forma *philippinensis*) : LUZON : Vidal 983 (Auth. spec. of *S. philippinensis* Brandis); Bur. For. 12996 (Auth. spec. of *S. pallida* Foxw.); Bur. For. 6068, 7084, 13924, 17158, 17643, 17652, 22290, 23471, 27007.

MINDANAO : Elmer 14175; For. Bur. 24331, 25021, 27710, 31281.

BASILAN : For. Bur. 18887; Bur. Sc. 15418, 16102.

CELEBES AND MOLUCCAS (forma *Koordersii*) :

MINAHASA : Herb. Koord. 16734*β* and 16735*β* (*V. celebica* Koord. ms.); 15982*β*, 16737*β*, 16739*β*, 16742*β* and 16796*β* (Auth. specs. of *S. Koordersii* Brandis).

TALIABU : Herb. Bog. 362.

PULAU BISA : Herb. Bog. 54 and 55.

Pulau Obi Herb. Bog. *s.n.*

The species which we in Malaya have been accustomed to call *Shorea globifera* is here recognized as a geographical race of a remarkably widely-distributed species occurring from Assam to the Moluccas. This species has been described separately in several different localities—as *S. assamica* in Assam, *S. globifera* in the Malay Peninsula, *S. philippinensis* in the Philippines, and *S. Koordersii* in Celebes. These are here united under the oldest specific name *S. assamica* but the various geographical races, which do exhibit slight differences, are recognized as *formæ*, or forms, the former specific epithets being retained to describe them. Thus our *S. globifera* Ridl. (meranti pipit) becomes *Shorea assamica* Dyer forma *globifera* (Ridl.) Sym.

Parashorea malaanonan (Blanco) Merr., Spec. Blanco. 271 (1918), et Enum. Philip. Flow. Pl. 3 : 100 (1923); V.Sl. in Bull. Jard. Bot. Buitenz. III, 8 : 375 (1927) et ex Merr., Plant. Elmer. Born. 202 (1929). *Mocanera malaanonan* Blanco, Fl. Philip. 858 (1837). *Dipterocarpus malaanonan* Blanco, op. cit. ed. 2 : 312 (1845) et ed. 3, II : 214 (1878). *Shorea malaanonan* (Blanco) Bl., Mus. Bot. Lugd.-Bat. 2 : 34 (1852); De Candolle, Prod. 16, pt. 2 : 631 (1868); Brandis in Journ. Linn. Soc. 31 : 103 (1895); non S. malaanonan sensu Merr. et Rolfe in Philip. Journ. Sci. (Bot.) 3 : 115 (1908), et sensu Foxw. in Philip. Journ. Sci. (Bot.) 6 : 270 (1911). *Parashorea plicata* Brandis in l.c. 104 (1895); Merr. et Rolfe in l.c. 114 (1908); Foxw. in l.c. 280 (1911), et in l.c. 13 : 194 (1918); Whitford, Philip. Bur. For. Bull. 10 : 63, tab. 60 & 61 (1911). *Parashorea Warburgii* Brandis in l.c. 105 (1895); Foxw. in Leafl. Philip. Bot. 6 : 1954 (1913) et in Philip. Journ. Sci. (Bot.) 13 : 194 (1918); Merr. in l.c. 100 (1923). **Plate 21.**

Parashorea malaanonan, if the interpretation here accepted is correct, first appeared in botanical literature in 1837 under the name of *Mocanera malaanonan* Blanco. Blanco's description, which was not materially amended in subsequent editions of his *Flora de Filipinas*, is translated as follows—

Leaves ovate-lanceolate, broad, frequently pointed, whitish on the under surface. Calyx divided almost to the base in 5 oblong segments which are slightly contorted over the fruit: the 3 outer segments longer and measuring about 3 inches. Corolla ..... Stamens ..... Nut oval, free when ripe, surrounded by the calyx, with delicate (fragile) shell crowned by the long style which bears 3 stigmas, unilocular and one-seeded, the seed with 3 or 4 lobes.

Large trees, known in Angat by the possibly equivocal name of malaanonan: the leaves are a "jeme" in length, wide, and*

* A "jeme" is the length of span between the tips of extended forefinger and thumb, *i.e.* about 8 in. or 20 cm.

Plate 21. *Parashorea malaanonan* (Blanco) Merr.

whitish and smooth (soft) beneath when young. This character sufficiently distinguishes the species from others in the genus. The tree also yields on aromatic resin, but in very small quantities.

Blanco neither cited nor left a type specimen. In the second and third editions of his work the name is changed to *Dipterocarpus malaanonan*. In 1852, in a conspectus of Malaysian species, Blume changed the genus to *Shorea*. He cited no specimen, and it would appear that he saw none but considered that the species described by Blanco, whatever it was, must be a *Shorea*. At that time the genus *Parashorea* was unknown and Blanco's description is essentially that of a *Shorea*, except that he says that the nut is free when ripe. Similarly De Candolle, in 1868, and Brandis, in 1895, enumerated *Shorea malaanonan*, but they made no attempt to tie this name down to any extant herbarium material.

The genus *Parashorea* was described by Kurz in 1870, the species enumerated being *P. stellata* from Burma and *P. lucida* from Sumatra. In 1895 Brandis added two new species from the Philippines, *P. plicata*, based on flowers and young fruits, and *P. Warburgii*, based on ripe fruits evidently picked from the ground.* He did not suspect that either, or both, of these might be the plant he enumerated as *Shorea malaanonan* (Blanco) Bl.

Merrill and Rolfe were the first to attempt to identify *Mocanera malaanonan* Blanco with existing herbarium material. In 1908 they identified Blanco's description with a species described by Vidal in 1883 as *Shorea polita*, citing a number of Philippine collections. The only supporting argument for this interpretation is the statement *"we are of opinion that the above specimens are referable to Blanco's species and accordingly his specific name is accepted, Vidal's Shorea polita being here reduced."* The numerous discrepancies between their plant and Blanco's description are not explained.

This interpretation of Merrill and Rolfe remained in current use in Philippine literature until 1918 when Merrill himself, in his *Species Blancoanæ*, rejected it. In this work he states—*"I am now convinced that this interpretation was erroneous; that* Shorea polita *is a valid species entirely distinct from* Mocanera malaanonan *Blanco; and that Blanco's species is identical with the common and widely distributed Philippine* Parashorea plicata *Brandis. Among all the Philippine Dipterocarpaceæ,* Parashorea plicata *Brandis is the only one that agrees with Blanco's description in the characters of the leaves, whitish beneath, which are further described as wide, pointed, and a "gome" (i.e. 15 to 18 cm.) long, while the pericarp of the fruit is described*

* *P. plicata* Brandis and *P. Warburgii* Brandis were united by Merrill and Rolfe in 1908, and by Foxworthy in 1911. In 1913 and 1918 Foxworthy, and in 1923 Merrill, separated them again, but in 1927 Van Slooten, with whom I am in agreement, reunited them.

as fragile. The description conforms to Parashorea plicata, *and I have not the slightest hesitation in adjusting the synonymy. The native name cited by Blanco,* malaanonan, *is valueless in interpreting the species, as it is a made up one, literally "false-anonang",* anonang = Cordia myxa *Linn., and, as used to-day, is very loosely applied, although I have specimens of* Parashorea plicata *Brandis from Laguna Province, Luzon, bearing this name".* Merrill cited an Illustrative Specimen No. 1053.

I agree with this second interpretation of Merrill's to this extent—*Parashorea plicata* Brandis answers more closely to Blanco's description of *Mocanera malaanonan* than does any other *known* Philippine dipterocarp. Nevertheless, Blanco describes the fruits as having a persistent style with three stigmas and wings only 3 in. long. These characters cannot be reconciled with *Parashorea plicata* and, had I been faced with the original interpretation of *Mocanera malaanonan,* I should certainly have regarded it as a *nomen dubium.* But in deference to the fact that van Slooten and others have accepted Merrill's second interpretation, and because there certainly is not adequate evidence to prove that he was wrong, it seems desirable to allow this interpretation to stand.

The first adequate description of *Parashorea malaanonan* Merr. is that published by van Slooten in 1927. This is a very satisfactory description of the species as I know it except concerning the leaves, of which van Slooten says *"the undersurface felt-like to the touch by an usually hardly visible stellate tomentose brownish indumentum, which may have a more or less intensely greyish-white hue especially in young leaves and in leaves of saplings, along the midrib and nerves, however usually finely adpressed pubescent, afterwards on the whole undersurface often glabrous or nearly so ....."* I am inclined to think that this gives a wrong impression of the immature leaves, as I have examined some specimens, obviously immature, which are almost entirely glabrous. Indeed it is possible that some of the specimens with tomentose leaves examined by van Slooten are not typical *P. malaanonan* but what I have described (*vide* p. 338) as *P. malaanonan* variety *tomentella.* The tomentose specimens concerned, which Dr. van Slooten has kindly communicated to me, are unfortunately all sterile and I do not think it is possible to say more at present than that they are referable either to *P. malaanonan* Merr. or *P. malaanonan* Merr. var. *tomentella* Sym. A careful field investigation of mature and immature stages of both forms will be necessary to decide the point.

Collections examined :—

BORNEO : Brunei : C.F. 30531.

British North Borneo : Villamil 20 (?); Elmer 21122 (H.B. 937.26.15), 21739 (H.B. 937.26.17); For. Dept. B.N.B.

No. 1; Wood 2266 (H.B. 937.26.1); C.F. 36722 (S.H. 3922), 38727 (S.H. 4351), 38738 (S.H. 4362), 38777 (S.H. 4401), 38833 (S.H. 4457), 39019 (S.H. 4643), 41065 (S.H. 4720), 41088 (S.H. 4951), 41122 (S.H. 5979).

PHILIPPINE ISLANDS:* MINDANAO: Warburg s.n. (Auth. spec. of *P. Warburgii* Brandis); Elmer 14066 (H.B. 937.26.23); Baker 6282; Bur. Agri. 356 (H.B. 937.26.19) (?); For. Bur. 9182, 11560, 12355, 24328, 27471, 27646, 27720, 29420.

NEGROS: Bur. Sc. 1144 and 1616; For. Bur. 11194, 11244, 11646 (H.B. 937.26.25), 12314, 13755, (H.B. 937.26.26), 17418, 17488, 22677 (H.B. 937.26.30), 29466, 29467, 30127.

PANAY: For. Bur. 17838, 22567, 22569.

LEYTE: Wenzel 711, For. Bur. 11635 (H.B. 937.26.24), 12624, 12769.

BILIRAN: Bur. Sc. 18489 and 18992.

SAMAR: For. Bur. 21077 (H.B. 937.26.22) and 25934.

MASBATE: Bur. Sc. 1673; For. Bur. 12570 and 12591.

CATANDUANES ISLAND: For. Bur. 6679.

POLILLO ISLAND: Bur. Sc. 10282.

LUZON: Vidal 76, 990, and 2033 (Auth. specs. of *P. plicata* Brandis); 1053 (Illustrative specimen of *P. malaanonan* Merr. in *Spec. Blanco.*: H.B. 937.26.21); Loher 113, 114, 14770; Elmer 17695 (H.B. 937.26.20); Bur. Agri. 51, 104 (H.B. 937.26.18), 291; Bur. Sc. 1461, 2660, 3289, 11944, 12274; For. Bur. 4528, 5754, 10010, 10016, 10059, 10071, 10176, 10404, 10500 (H.B. 937.26.27), 10502, 10506, 10584, 10603, 10668, 10703, 10739, 11520, 12775, 14338, 15438, 17629, 20251, 20711, 21196, 21412, 21694, 21717, 22249, 22250, 22346, 22634, 23771, 29819.

The following specimens may be either *P. malaanonan* Merr. or *P. malaanonan* var. *tomentella* Sym.:—

BORNEO: SOUTH EAST BORNEO: Endert 5165 (H.B. 937.26.14); bb. 10848 (H.B. 937.26.9), bb. 11286 (H.B. 937.26.10), bb. 11661 (H.B. 937.26.16), bb. 12119 (H.B. 937.26.12), bb. 12145 (H.B. 937.26.11), bb. 18888 (H.B. 937.26.2); bb. 18892. (H.B. 937.26.3), bb. 18899 (H.B. 937.26.4), bb. 18903 (H.B. 937.26.5), bb. 19131 (H.B. 937.26.6), bb. 19144 (H.B. 937.26.8), bb. 19149 (H.B. 937.26.7).

BRITISH NORTH BORNEO: Elmer 21194 (H.B. 937.26.16).

PHILIPPINE ISLANDS: MINDANAO: Hutchinson 7563 (H.B. 937.26.28).

* Some of the specimens listed from the Philippines are apparently from seedling or sapling trees. The identification of such specimens should be considered as tentative. Unfortunately, when examining the specimens I failed to list which had mature leaves and which immature.

LUZON: For. Bur. 6047, 10221 (H.B. 937.26.29), 14936, 29347.

Parashorea malaanonan (Blanco) Merr. var. **tomentella** Symington, **var. nov.**, "*Parashorea* sp.", A. V. Thomas in Mal. Forester 4: 131 (1935) partim; Sym. ex Desch, Mal. For. Rec. 12: 33 (1936). **Plate 22.**

Parashorea malaanonan (Blanco) Merr. forma typica valde affinis, a qua foliis subtus tomentosis, stylis appendicibusque brevioribus differt.

Branchlets pale fulvous-tomentose, finally becoming dark and glabrescent, annular stipular scars conspicuous. *Leaves* ovate to elliptic-lanceolate, acute or bluntly acuminate at the apex (the apices of nearly all the leaves of my specimens are damaged), rounded or sub-cordate (occasionally acute at one side) and more or less unequal at the base, very variable in size from about 8.0 × 3.0 cm. to 24.0 × 13.0 cm. or more, glabrous and shining above, covered with a pale fulvous felt-like tomentum beneath, ridges between the main nerves sometimes conspicuous; midrib slightly elevate in the lower portion on the upper surface, prominent beneath; main nerves about 12 to 16 pairs, inconspicuous above, prominent beneath; nervules join the main nerves in fine wavy sub-parallel lines; petioles 1.5 to 2.5 cm. long, thick, rugose, tomentose; stipules caducous (not seen), leaving annular scars. *Panicles* terminal or in the upper leaf-axils, racemose, lax, pale cinereous- or fulvous-tomentose, about as long as the leaves; ultimate branchlets about 3.0 to 6.0 cm. long, somewhat zig-zag, 2 to 6-flowered. *Flowers* sub-secund, 1.0 to 1.5 cm. apart in mature panicles, subtended by caducous bracteoles leaving prominent scars, about 14.0 mm. long in mature bud, about 3.5 cm. across when expanded, usually said to be white (occasionally creamy yellow). *Sepals* pale close-tomentose on both surfaces; three outer oblong-obtuse; two inner ovate-acuminate, very slightly shorter. *Petals* oblong-obtuse, pale tomentose outside and along one edge inside. *Stamens* 15, in three rows, the inner row of 5 slightly taller than the other rows which are sub-equal; filaments short, flattened, broad at the base, narrow above, occasionally furnished at the sides with a few fine hairs; anthers oblong, about 3 times as long as the filaments, sagittate at the base, cells pointed at the apex the two inner slightly shorter than the outer; appendage to connective awl-shaped, thick at the base, about one half to as long as the anther. *Ovary* ovate-conical, tapering gradually into the cylindrical style; style about as long as the sepals in mature flowers, tomentose on the lower half, glabrous above; stigma minute, flat. *Fruit* a 5-winged nut (mature fruit not seen); stalk short or almost absent, stellate hairy; bases of accrescent calyx lobes shortly united to embrace the lower third of the nut, also stellate hairy; three outer calyx

Plate 22. *Parashorea malaanonan* var. *tomentella* Sym.

lobes linear-oblanceolate or spathulate, rounded at the apex, about 14.0 cm. long and 1.5 to 3.0 cm. broad, 9 to 12-nerved, sparsely hairy; two inner lobes linear-acute, about 3.0 to 7.0 cm. long and up to 6.0 mm. broad but usually much narrower, 3 to 6-nerved; nut (immature) pale tomentose, surmounted by the long style which is glabrous on the upper portion.

Recent study of the timber commonly known as "Borneo white seraya" has necessitated botanical investigation of the identity of the tree, or trees, producing it. It was generally assumed that the main source of the timber was a single botanical species, *Parashorea malaanonan* (Blanco) Merr. Sterile botanical material, authenticating two logs (from different trees) used for pilot tests was thought by me (*vide* Thomas, in *l.c.*) to belong to the same species, although the specimens differed considerably in leaf indumentum. The subsequent receipt at Kepong of numerous collections of fertile material of *Parashorea* from British North Borneo led me to suspect that these specimens represent two distinct, possibly specifically distinct, forms. Examination of flowering collections confirms this suspicion. The smooth-leaved collections are *Parashorea malaanonan* (Blanco) Merr. and those with tomentose leaves. I am naming *P. malaanonan* var. *tomentella*. The main differences between these two forms are as follows—

P. malaanonan—mature leaves smooth and usually glaucescent on the undersurface; style long, exceeding the sepals, tomentose on the lower third only; appendage to connective longer than the filament and anther.

P. malaanonan var. *tomentella*—mature leaves covered with a close, pale, fulvous, stellate tomentum; style not or hardly exceeding the sepals of mature flowers, tomentose on the lower half; appendage to connective less than half the length of, to as long as the anther.

I have resisted a strong temptation to describe this tomentose form as a new species. If one considers the recent collections of *Parashorea* from British North Borneo alone, the two forms appear in sharp contrast and there would appear to be little justification for not recognizing two distinct, but closely related, species. Further, Mr. Keith informs me that specific separation would be justified, from a consideration of field characters. There are, however, several collections (unfortunately all sterile), mainly from South East Borneo but some from British North Borneo, Mindanao, and Luzon, which appear to be intermediate between the two. These collections are listed as "either *P. malaanonan* Merr. or *P. malaanonan* var. *tomentella* Sym." on p. 338. In 1911 Foxworthy (in *Philip. Journ. Sci.* (*Bot.*) 6 : 281) cited some of these collections from British North Borneo and

from Luzon, referring to them as a form of *Parashorea plicata* "*which is pubescent on the young twigs and on the undersides of the leaves*". In 1927 van Slooten cited Elmer 21194 from British North Borneo and several collections from South Borneo under *Parashorea malaanonan*, considering that they represented a juvenile form of the leaves of that species.

These specimens I have segregated from either *P. malaanonan* or the variety *tomentella*. As I have remarked on p. 337, further field investigation is required to decide their status, and when this decision is made the question of raising *Parashorea malaanonan* var. *tomentella* to specific rank should be reconsidered.

Collections of *P. malaanonan* var. *tomentella* examined:—

BRITISH NORTH BORNEO: C.F. 38745 (S.H. 4369) (Type of *P. malaanonan* var. *tomentella* Sym.); Otik; Kabili Forest Reserve, Sandakan, level land; 23rd March, 1935; flower. Field notes—"vern. name, *urat mata;* tree 150 feet high, 65 in. girth; flower white".

For Dept. B.N.B. No. 2; C.F. 36673 (S.H. No. 3896), 38687 (S.H. 4310), 38726 (S.H. 4350), 38734 (S.H. 4358), 38845 (S.H. 4469), 38854 (S.H. 4478), 38871 (S.H. 4485), 38935 (S.H. 4559), 38972 (S.H. 4596), 41061 (S.H. 4712), 41064 (S.H. 4719), 41087 (S.H. 4950), 41289 (S.H. 7154), 41332 (S.H. 7197).

The main source of the commercial timber called "Borneo white seraya" has been generally supposed to be a single botanical species, *Parashorea malaanonan*, which is known in the jungle in British North Borneo as *urat mata*. Two forms of *urat mata* have, however, been recognized—one with smooth leaves and the other with tomentose leaves. The botanical identity and status of these forms is here investigated, and it is shown that only the smooth-leaved form is *Parashorea malaanonan* in the strict botanical sense. The form with tomentose leaves is described as a variety of *P. malaanonan*— var. *tomentella*. It is considered that this variety may be worthy to rank as a distinct species but further investigation, particularly of immature stages in the field, is required to decide the point.

Shorea acuminatissima Symington, **sp. nov. Plate 23.**

S. Faguetianæ Heim valde affinis, sed ramulis novellis ferrugineo-tomentosis et foliis caudato-acuminatis infra scabriusculis distincta.

Branchlets densely or sparcely ferruginous-tomentose when young, later terete, glabrous, and dark. *Leaves* ovate- or oblong-lanceolate, caudate-acuminate at the apex, rounded or sub-acute at the base, margins slightly revolute, about 7.0 × 2.5 cm. to 17.0 × 6.0 cm., glabrous and drying yellow- or red-brown above,

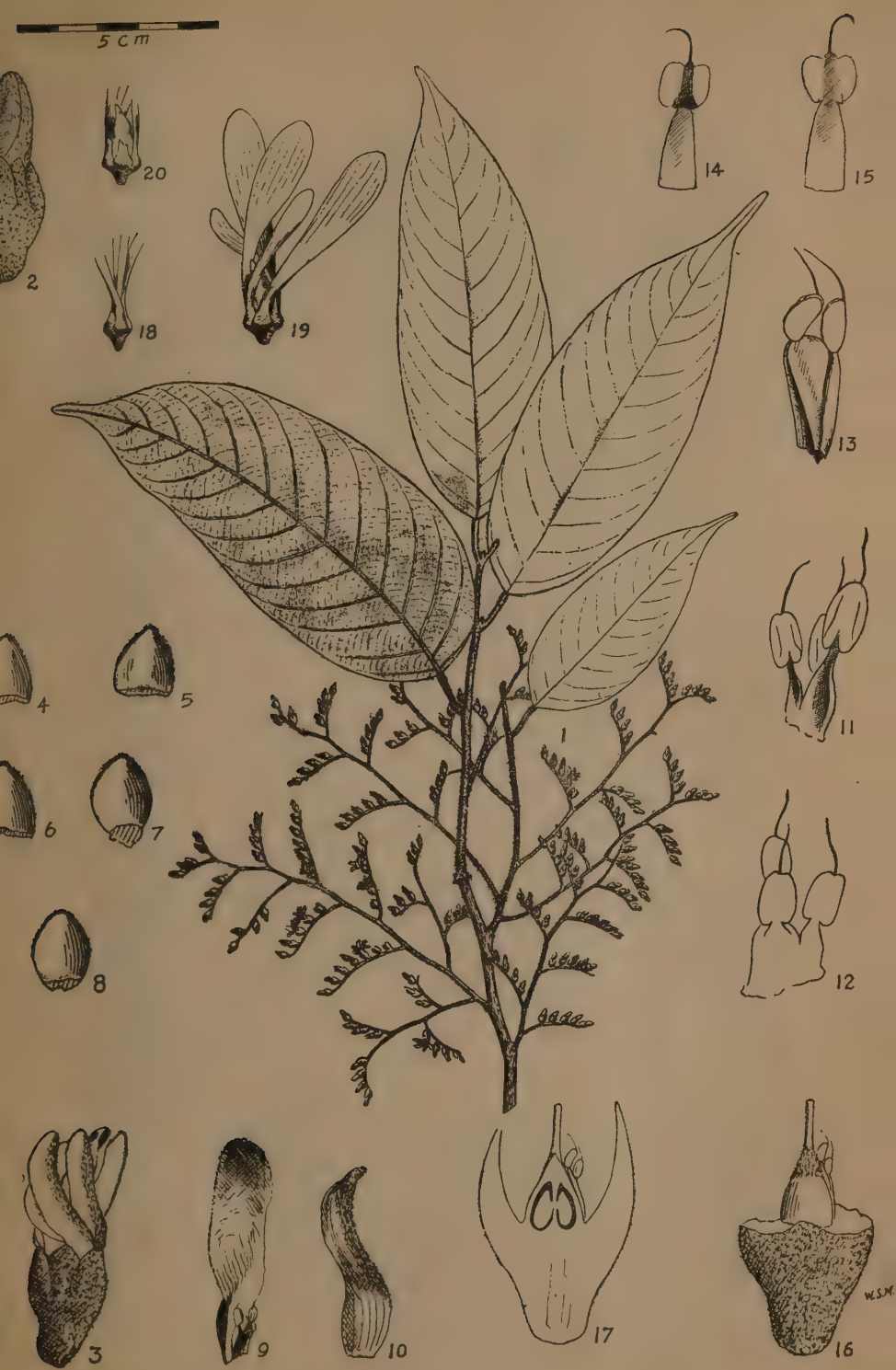

Plate 23. *Shorea acuminatissima* Sym.

similarly coloured but scabrid stellate-hairy on the nerves beneath; midrib slightly depressed above, prominent and stellate-hairy beneath; main nerves about 13 to 18 pairs, inconspicuous above, strongly elevate and stellate-hairy beneath; nervules faint but visible on both surfaces, usually sparsely hairy beneath; petioles terete, 1.0 to 1.5 cm. long, ferruginous-tomentose when young, scabrous and black later; stipules broadly oblong, oblique, rounded, about 1.0 × 0.5 cm., stellate-hairy, caducous. *Panicles* axillary and terminal, usually solitary, racemose, shorter than the leaves, pale tomentose; branchlets about 0.6 cm. apart, 1.0 to 2.0 cm. long when mature, each bearing 4 to 6 secund flowers (in the immature panicle the flower buds are sub-distichous and subtended by small, frequently bifurcate, puberulous bracteoles). *Flowers* about 2.0 mm. apart, ovate-lanceolate in mature bud, about 7.0 mm. long including the pedicel; pedicel 1.0 mm. long, densely pale tomentose. *Sepals* sub-equal, ovate-rotundate, obtuse, tomentose on the portions exposed in bud, white (C.F. 38722 & 38723). *Stamens* 15, pairs alternating with single stamens, of three sizes; anthers ovate-oblong, 2-celled; filaments about as long as the anthers, broad at the base, narrowing slightly towards the top; appendage to connective filiform, about as long as the anther. *Ovary* and stylopodium conical, the former glabrous, the latter densely hairy; style about as long as the stylopodium, cylindrical, glabrous; stigma capitate, small. *Fruit* sessile; calyx lobes chartaceous, sparsely hairy, three outer larger than the inner two; large wings spathulate, about 5.0 × 1.2 cm.; small wings similar but slightly (or considerably) smaller; bases of fruiting sepals thickened and woody, closely appressed to the base of the nut to form a 5-angled stellate-hairy cup, pointed at the base; mature nut ovate-oblong, rostrate, about 1.5 × 0.7 cm., densely fulvous-tomentose.

This is a typical member of the *Richetia* group of *Shorea* and appears more closely related to *S. Faguetiana* Heim than to any others with which I am familiar. The leaves are rather distinctive, and there should be little difficulty in identifying the species from vegetative characters alone. There is a distinct resemblance in leaf to *Shorea Forbesii* Brandis from New Guinea, but the natural relationship to it is remote. I suspect that *S. Forbesii* is a *Hopea*.

Collections examined :—

BRITISH NORTH BORNEO : C.F. 38723 (S.H. 4347) (Type of *S. acuminatissima* Sym.); Ayan; Experimental Station, 8th mile Sandakan, level land in forest; 29th March, 1935; flower. Field notes—"vern. name, *gagil;* tree 120 feet high, 53 in. girth; flower small, white, in cluster".

C.F. 41075 (S.H. 4886) (Paratype of fruit of *S. acuminatissima* Sym.); Puasa; Kabuli Forest Reserve, Sandakan, top

of hill; 21st April, 1935; fruit. Field notes—"vern. name *selangan kuning;* tree 90 feet high, 60 in. girth; fruit red".

C.F. 38722 (S.H. 4346), 38724 (S.H. 4348), 38792 (S.H. 4416).

BRUNEI: C.F. 30404.

The species here described as *Shorea acuminatissima* is a large tree which has been collected several times from British North Borneo under the names "*gagil*" and "*selangan kacha*". It has also been collected in Brunei. Timber samples have not been available for study but, from botanical considerations, it may safely be said that the timber will be classified as "white meranti sub-group 2" (*vide* Desch, *Mal. For. Rec.* 12: 37).

Shorea xanthophylla Symington, **sp. nov. Plate 24.**

S. multiflorœ (Burck) Sym. valde affinis sed foliis fructuque majoribus, petalis pro rata brevioribus, appendicibus ciliatis, differt.

Branchlets grey- or reddish-brown, pale puberulous towards the ends. *Leaves* oblong, acuminate at the apex, rounded or sub-cordate at the base, from about 19.0 × 6.0 cm. to 37.0 × 10.0 cm., glabrous on both surfaces, drying yellow-brown or greenish-yellow on the lower surface, usually of a greener tinge above; midrib very slightly elevate above, prominent beneath; main nerves 9 to 13 pairs, faint above, prominent beneath; nervules joining the main nerves in rather distant sub-parallel lines, invisible or faint above, rather prominent beneath; petioles 1.0 to 2.0 cm. long, rather thick, dark, rugose; stipules not seen. *Panicles* axillary or terminal, solitary or several together, lax, up to about 14.0 cm. long, pale tomentose; branches solitary or in pairs, irregularly branched; ultimate branchlets with 1 to 6 sub-secund flowers 1.3 mm. apart. *Flowers* ovate-lanceolate in nature bud, about 5.0 mm. long (including the pedicel); pedicel 1.0 mm. long, pale tomentose. *Sepals* sub-equal, ovate-rotundate, mucronate rounded or emarginate at the apex, tomentose outside, glabrous within. *Petals* oblong, tomentose on the portion exposed in bud, said to be white (38938), yellow (38742), lemon yellow (36776), and yellow ochre (38933). *Stamens* 15, pairs alternating with single stamens, of three heights; anthers elliptic-oblong, 2-celled; filaments 1 to 2 times as long as the anthers, broad at the base, narrow in the upper half; appendage to connective a curved awn about as long as the anther, minutely ciliate towards the end. *Ovary* ovate-conical, glabrous below, tomentose in the upper portion; style cylindrical, about ⅓ as long as the ovary, glabrous; stigma minute, apparently simple. *Fruit* sub-sessile; calyx lobes sub-equal, broadly ovate, about 1.0 cm. × 0.7 cm., decidous fulvous-tomentose, shortly united at their bases to form a woody receptacle; nut obovate, pointed, about 2.3 cm. × 1.7 cm., striate,

Plate 24. *Shorea xanthophylla* Sym.

Plate 25. *Shorea sandakanensis* Sym.

fulvous tomentose, on germination splitting along three lines at the apex.

This is yet another species of the *Richetia* group (*vide* p. 330). It is extremely close to *Shorea multiflora* (Burck) Sym. but differs markedly in the size of leaf and fruit.

Collections examined :—

BRITISH NORTH BORNEO: C.F. 36776 (S.H. 3998) (Type of *S. xanthophylla* Sym.); Puasa; Bettotan, Sandakan, top of hill; 23rd Sept. 1934; flower. Field notes—"Vern. name, *Karai batu;* tree 70 feet high, 18 in. girth; flower lemon yellow."

C.F. 38742 (S.H. 4366), 38933 (S.H. 4557), 38938 (S.H. 4562), 41108 (S.H. 5496).

SARAWAK: For. Dept. Sar. 00277 (Paratype of fruit of *S. xanthophylla* Sym.); Bogil; Sungei Babong, Beseri, hill; 6th August, 1935; mature fruit. Field notes—"tree 40 feet high, 21 in. girth".

Shorea xanthophylla is a "new" species which has been recorded several times in the neighbourhood of Sandakan in British North Borneo and once in Sarawak. Our only information concerning the tree is that given on the herbarium labels of native collectors. It appears to be a small to medium-sized tree of low hills for which the following vernacular names have been recorded in B.N.B.—*selangan babi, selangan kuning,* and *karai batu. Pisang-pisang* has also been recorded on two occasions, possibly on account of a supposed leaf resemblance to some species of *Anonaceæ*. Timber specimens have never been collected but, from botanical considerations, there can be little doubt that the timber should be classified as "white meranti sub-group 2" (*vide* Desch, *Mal. For. Rec.* 12 : 37). The specific epithet, *xanthophylla*, refers to the characteristic yellowish colour of the dried leaves.

Shorea sandakanensis Symington, **sp. nov. Plate 25.**

S. macropteræ Dyer affinis, sed foliis majoribus minus coriaceis, paniculis longioribus laxioribus, floribus majoribus, alis fructus longioribus, nuce subgloboso dense tomentoso differt.

Branchlets terete, tawny-tomentose when young, later becoming dark. *Leaves* oblong, acuminate at the apex (acumen about 1.5 cm. long), truncate or rounded at the base, usually about 18.0 × 6.5 cm. but varying from about 9.0 × 4.0 cm. to 23.0 × 9.5 cm., glabrous above, sparsely stellate-hairy on the nerves beneath, usually drying yellow-brown on both surfaces; midrib slightly depressed above, prominent striate and sparsely hairy beneath; main nerves 13 to 15 pairs, inconspicuous above, prominent beneath; nervules in fine curved parallel lines, distinctly visible but not very prominent on either surface;

petioles 1.0 to 2.0 cm. long, rugulose, tawny-tomentose to black; stipules oblong, less than 1.0 cm. long, caducous. *Panicles* axillary and terminal, solitary, when axillary shorter than the leaves; main branches rufescent-tomentose, pale tomentose towards the ends; ultimate branchlets regularly alternating about 1.5 cm. apart, usually simple but occasionally bifurcated, 1.0 to 3.0 cm. long, bearing 3 to 7 (usually 5) distichous flowers. *Flowers* "red, no odour" (38730), "olive green" (38839), "lake green" (38778), about 5.0 cm. apart, sessile, about 1.0 cm. long in mature bud. *Sepals* sub-equal, ovate-rotundate, acute, pale to silvery tomentose outside, glabrous within. *Petals* linear-oblong to linear, tawny-villous on the portions exposed in bud. *Stamens* 15, of three sizes; filaments flattened, broad at the base, gradually narrowing upwards; anthers globular, cells sub-equal; appendage to connective a curved awn about as long as the anther (slightly shorter in large stamens), at first erect, later deflexed. *Ovary* and stylopodium cylindric-conical, glabrous in the lower portion, villous above; style terete, glabrous, about half the length of the ovary and stylopodium; stigma very slightly enlarged, obscurely 3-lobed. *Fruit* a 5-winged nut; sessile; bases of accrescent calyx lobes thickened, woody, embracing the lower portion of the nut only, minutely stellate-hairy; three outer wings sub-equal, linear, rounded at the apex, auriculate at the base, about 11.0 × 1.5 cm. to 14.0 × 2.0 cm., 9 to 11-nerved, sparsely minutely hairy, red when young (C.F. 41051); two inner wings much shorter, linear, irregular at apex, about 3.0 × 0.5 cm. to 6.0 × 0.7 cm., about 5-nerved; nut ovate-globular, rostrate, about 1.8 × 1.2 cm., densely pale tawny-tomentose; rostellum about 3.0 mm. long, pale tawny-tomentose.

There are several Bornean forms, some as yet undescribed, closely related to *Shorea macroptera* Dyer from the Malay Peninsula. So close, indeed, are they that some authors would probably interpret them as variations of a polymorphous species. One of these forms (*S. Bailloni* Heim) was actually united with the Peninsula species by Brandis (*Journ. Linn. Soc.* 31: 90 (1895)). As herbarium material of these forms accumulates, however, it becomes increasingly evident that the differences are such as to justify the recognition of several distinct species. The differences between *S. sandakanensis* and *S. macroptera* Dyer are of degree rather than kind, nevertheless, the sum of these differences is so constant that I feel confident in separating them specifically.

Collections examined :—

BRITISH NORTH BORNEO: C.F. 38730 (S.H. 4354) (Type of *S. sandakanensis* Sym.); Agama; Kabuli Forest Reserve, Sandakan, level ground; 16th March, 1935; flower. Field

Plate 26. *Shorea Smithiana* Sym.

Notes—"vern. name, *seraya;* tree, 100 ft. high, 60 in. girth; flower red, no odour; this form of seraya has usually short bole".

C.F. 38760 (S.H. 4384), C.F. 38765 (S.H. 4389), C.F. 38778 (S.H. 4402), C.F. 38839 (S.H. 4463), C.F. 38893 (S.H. 4517), C.F. 38946 (S.H. 4570), C.F. 41051 (S.H. 4676), C.F. 41068 (S.H. 4850: Paratype of fruit of *S. sandakanensis* Sym.); Agama; Kabuli—Sepilok Forest Reserve, Sandakan, level ground; 5th June, 1935; fruit. Field Notes—"vern. name, *seraya;* tree 40 ft. high, 32 in. girth; fruit greenish-red".

? Creagh, s.n., July 1896.*

Shorea sandakanensis appears to be common in the vicinity of Sandakan, on flat land or on low hills. The majority of the collections have been named *seraya,* but one is named *seraya puteh,* and one *selangan bangar.* It appears to grow to great size, one tree of 200 ft. in height and 108 in. girth being recorded.

Shorea Smithiana Symington, **sp. nov.** "*Shorea* sp. No. 21606," van Slooten ex Merr. Plant. Elmer. Born. 205 (1929). **Plate 26.**

S. rugosa Heim foliorum ramulorumque habitu similis, sed staminibus 22–26, antheris late oblongis, connectivorum appendicibus filiformibus, stylopodio oblongo basi constricto distincta.

Branchlets rather coarse, dark, glabrescent to fulvous scabrous stellate-tomentose at the ends. *Leaves* broadly obovate to elliptic-oblong, acute or shortly blunt acuminate at the apex, truncate to cordate at the base, about 10.0 × 6.0 cm. to 17.0 × 8.5 cm., sparsely stellate-hairy and drying dull grey-brown above fulvous-tomentose on the lower surface; midrib depressed and stellate-tomentose above, elevate, thick, closely tomentose, and furnished with coarse scabrous hairs beneath; main nerves 15 to 20 pairs, inconspicuous above, elevate, tomentose, and scabrous hairy beneath; nervules faint and sparcely hairy above, in conspicuous parallel lines, tomentose and scabrous hairy beneath; petioles 2.0 to 3.0 cm. long, rugulous, fulvous scabrid-tomentose; stipules about 1.0 cm. long, oblong, subfalcate, scabrid-tomentose, caducous. *Panicles* terminal and axillary, in solitary racemes usually larger than the leaves (up to 23.0 cm. long), fulvous-tomentose becoming paler at the branchlets; branchlets regularly alternating, about 1.0 cm. apart, up to 3.5 cm. long, decreasing in length towards the end of the raceme, 3- to 8-flowered; branchlets and flowers furnished with sub-ovate, obtuse, pale

* I examined this specimen (in young fruit) at Kew and was of opinion that it is this species, although the leaves have dried a rather unusual purple-grey colour.

tomentose bracts and bracteoles about 7.0 mm. long. *Flowers* secund, about 2.0 to 3.0 mm. apart, ovate-lanceolate in bud, about 1.0 cm. long including the pedicel; pedicel 1.0 mm. long, tomentose. *Sepals* sub-equal ovate-acute, the two inner slightly thinner and sub-acuminate, tomentose outside. *Petals* linear-oblong, blunt, silvery tawny-tomentose on the portions exposed in bud, pink (Smith), red (Kamis, 41071). *Stamens* 22 to 26, of three heights; filaments broad and flattened at the base, narrowing abruptly to the filamentous upper portion; anthers broadly oblong, much shorter than the filaments, 4-celled, cells sub-equal; appendage to connective filiform, about as long as the filament. *Ovary* and stylopodium shaped like an hour-glass, tomentose; style short, cylindrical, glabrous; stigma minute. *Fruit* a 5-winged nut; stalk very short, about 2.0 mm. long, sparsely stellate-hairy; bases of accrescent calyx lobes thickened and woody, closely embracing the lower half of the nut, sparcely stellate-hairy; three outer wings linear, obtuse at the apex, up to about 15.0 × 2.0 cm., sparsely minutely hairy, 7- to 10-nerved with arched or sub-reticulate nervules; two inner wings similar but about ¾ as long as the outer wings and with fewer nerves; nut ovate-conical, rostellate, about 2.0 × 1.4 cm., pale silky tawny-tomentose; rostellum about 5.0 mm. long, sharp and slightly curved.

This species resembles *S. rugosa* Heim in vegetative characters but it is quite distinct in details of floral morphology. I can suggest no closely-related species. The stamens, ovary, and stylopodium, are of the type seen in the *Pierrea* group of *Hopea* but rare in *Shorea*. The same combination may be seen in *S. compressa* Burck and *S. mecistopteryx* Ridl., but *S. Smithiana* differs from these in the more numerous stamens and, taking into consideration the sum total of their characters, I do not feel that the relationship is very close.

Collections examined :—

BRUNEI : C.F. 30472 (Type of *S. Smithiana* Sym.); J.S. Smith; Labi Hills, hillside 700 ft.; 25th Nov. 1934; flower. Field notes—"Tree 150 feet high, 12 feet girth; flower pink; bark brown with very deep fissures; large buttresses".

C.F. 30524 (Paratype of fruit of *S. Smithiana* Sym.); J.S. Smith; 23rd Feb. 1935; fruit from same tree as C.F. 30472.

C.F. 30538 and 39646.

BRITISH NORTH BORNEO : C.F. 36727, 39018 (S.H. 4642), 41070 (S.H. 4858), 41071 (S.H. 4860), 41080 (S.H. 4932); Elmer No. 21606 (Sun Yatsen No. 56097).

This new *Shorea* was first collected in British North Borneo by A. D. E. Elmer about 1922, but it was not until 1934–35 that

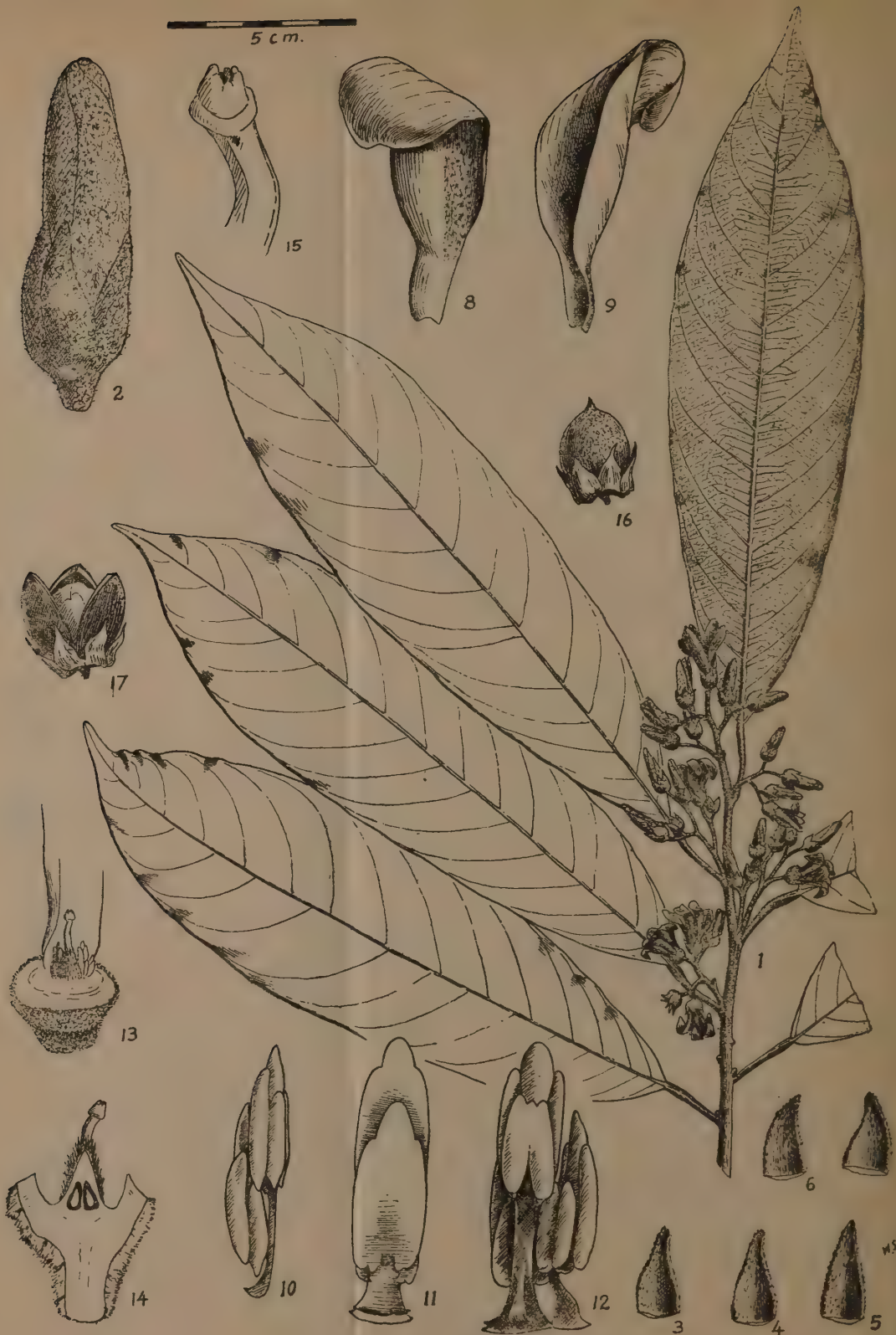

Plate 27. *Vatica diospyroides* Sym.

adequate material was available for purposes of description. During 1934–35 the species was collected in flower or fruit several times in both British North Borneo and Brunei. From the former territory the names *urat mata, seraya,* and *seraya merah,* are recorded, and from the latter *berat* (Murut) and *mengkabang rambai* (Dyak). It is evidently a good-sized tree, specimens over 12 feet girth having been recorded; it produces a timber apparently of the "light red meranti" grade.

I have named the tree after Mr. J. S. Smith, State Forest Officer, Brunei, from 1933–1936, whose interest in the collection of botanical material has resulted in invaluable contributions to our knowledge of Bornean trees.

Vatica diospyroides Symington, **sp. nov.** *Vatica Scortechinii* (King) sensu Brandis in Journ. Linn. Soc. 31 : 122 (1895), sensu Craib, Flor. Siam Enum. 1 : 141 (1925), et sensu V. Sl. in Bull. Jard. Bot. Buitenz. III, 9 : 108 (1927), quoad Curtis 2934; non *Retinodendron Scortechinii* King. **Plate 27.**

A *V. Scortechinii* (King) Brandis foliis tenuioribus, stipulis caducis, fructu majore, calycis lobis acuminatis recedit.

Branchlets pale, fuscous stellate-tomentose towards the ends. *Leaves* oblong or linear-oblong, acuminate at the apex, acute at the base, from about 12.0 × 2.7 cm. to 27.0 × 8.25 cm., glabrous and drying a pale yellow-green on both surfaces; midrib elevate on both surfaces, particularly the lower, pale yellow; main nerves about 15 to 21 pairs, prominent beneath, slightly less prominent above, usually with 2 to 4 short intermediary nerves; nervules reticulate, prominent on the lower surface; petioles 1.0 to 2.5 cm. long, rather thick, rugulose above, fuscous-tomentose when young; stipules not seen. *Panicles* axillary and terminal, solitary or 2 to 3 together, racemose, 2.0 to 4.0 cm. long, fulvous flocculent stellate-tomentose, about 3- to 12- flowered. *Flowers* lanceolate-oblong in bud, about 1.5 cm. long (including the pedicel); pedicel 2.0 mm. long or almost absent, fulvous flocculent stellate-tomentose. *Sepals* all similar, slightly imbricate or pseudo-valvate, deltoid-acuminate or ovate-acute, tomentose on both surfaces. *Petals* slightly contorted in bud, oblong-obtuse, densely fulvous-tomentose on the portions exposed in bud, "creamy white, very fragrant" (Kerr). *Stamens* 15 (rarely 13 or 14), of three heights, episepalous pairs alternating with solitary intermediate stamens; filaments short, flattened, broad at the base; anthers much larger than the filaments except in the tallest row of stamens, posterior cells much shorter than the anterior; appendage to connective short, thick, claviform. *Ovary* small, conical, ferruginous-pilose; style about as long as, to twice as long as, the ovary, ridged, glabrous; stigma sub-conical, ringed at the base, obscurely 3- to 6-lobed. *Fruit* : stalk short, 2.0 mm. long,

fuscous-tomentose; sepals united at the base to form a thin concave disc, lobes ovate, caudate-acuminate, margins sinuate, about 1.5 × 0.75 cm., sub-verrucose with a sparse pale tomentum; nut ovate-globose, rostellate, about 2.5 × 2.0 cm., fulvous farinaceous-tomentose; rostellum slightly curved, about 3.0 mm. long; pericarp thick, woody, splitting into three equal portions.

This is a very distinct species of *Vatica* which differs from most species in the subgenus *Isauxis* in lacking recurved fruiting sepals. The fruits in this respect more closely resemble those of *V. Scortechinii* (King) Brandis and *V. sarawakensis* Heim than any others, but the flocculent inflorescence is more suggestive of the subgenus *Synaptea*. The earliest collection was made by Curtis in Pang-nga in 1893, but this was referred by Brandis to *Vatica Scortechinii* (King). The latter, however, is quite distinct in the broader and thicker leaves, the large persistent stipules, and the smaller grooved fruits with obtuse calyx-lobes.

Collections examined :—

SIAM: Kerr 10011 (Paratype of flower of *V. diospyroides* Sym.); A. F. G. Kerr; Bangkok, altitude 5 m.; 27th Jan. 1925; flower. Field notes—"Local name, *chan ta paw;* shrub about 3 m. high; cultivated for its fragrant flowers."

Kerr 20546 (Type of *V. diospyroides* Sym.); leg. Heya Wruit Waradern (?); Bangkok; 19th July, 1931; mature fruit. Field notes—"Local name, *chan kapaw;* tree; cultivated for its fragrant flowers".

Kerr 17045 (Takuapa), 18286 (Surat), 18527 (Pang-nga); Curtis 2934 (Pang-nga); For. Dept. Siam 819.

This species is evidently a small tree which has been collected wild in evergreen forest in Peninsular Siam. The type specimens, however, came from Bangkok where the tree is said to be cultivated for its fragrant flowers. The name *Vatica diospyroides* is given because the fruits bear a distinct resemblance to those of certain species of *Diospyros*.

Oxford-Borneo Expedition 1932—Additional Dipterocarpaceæ

Shorea mecistopteryx Ridl. in Kew Bull. 1925: 280; V.Sl. ex Merr. in Univ. Calif. Pub. Bot. 15 : 203 (1929).

Native Collector No. 2269; Dulit, under 300 m., primary forest; Oct. 18th, 1932; flower. Field note—"*Urat Mata,* tree, 39 m. high. Large buttresses. Bark 0.8–1.0 cm. thick, reddish in blaze, surface yellowish grey, smooth, flaking off in large thin irregular pieces. Not the same species as the tree of same name at Marudi. Timber Class I (c)."

Shorea mecistopteryx has been known hitherto only from two fruiting collections (Taha *s.n.* (the type) and Elmer 21569) from

localities near Sandakan in British North Borneo. The leaf shape and distinctive soft indumentum are so characteristic that I feel justified in referring the Dulit collection to this species. Flowering material from the type locality is, however, desirable to put the matter beyond doubt. The following is a description of the flowers of the Sarawak plant—

Panicles axillary, stellate-tomentose, ferruginous on the main stem, grey on the branchlets, racemose, up to 12.0 cm. long; branchlets simple or branched, about 1.0 to 4.0 cm. long, each bearing 2 to 6 flowers subtended by sub-persistent bracteoles; bracteoles oblong, obtuse, sparsely sericeous-tomentose outside, glabrescent within. *Flowers* elongate-pointed in bud, up to 1.8 cm. long including the pedicel; pedicel 2.0 mm. long, pale tomentose. *Sepals* tomentose outside, minutely so on the upper half inside; three outer oblong, rounded at the apex; two inner slightly shorter, acute at the apex. *Petals* linear-oblong, rounded at the apex, pale tomentose outside on the portion exposed in bud. *Stamens* 15, of two different heights, pairs alternating with single stamens; filaments broad at the base, thickened above, then narrowing abruptly to a short filamentous portion, three to four times as long as the anthers; anthers rotund-ovate, cells sub-equal in size; appendage to connective filiform, about 1 to 3 times as long as the stamen. *Ovary* with stylopodium shaped like an hour glass (as in *Pierrea* group of *Hopea*), glabrous; style short; stigma obscurely 3-notched.

On floral characters this species appears to be related to *S. pinanga* Scheff. and *S. compressa* Burck, species characterized by a similar ovary and long, filiform connectival appendages.

Van Slooten (*op. cit.* p. 202) has questioned whether *S. chrysophylla* Ridl. (*Kew Bull.* 1926 : 470) differs from *S. mecistopteryx* Ridl. The collection described above lends support to Ridley's view. Although the ovary and stylopodium in *S. mecistopteryx* are exactly similar to those of *S. chrysophylla*, the indumentum of the leaves is quite distinct.

Cotylelobium malayanum V.Sl. in Bull. Jard. Bot. Buitenz. III, 12, pt. 1 : 43 (1932). *Cotylelobium flavum* sensu V. Sl. in op. cit. 10 : 396, fig. 1 (1930), non Pierre, Fl. For. Cochinch., tab. 258A (1891).

P. W. Richards No. 1816; Ulu Koyan, Mt. Dulit, c. 900 m., white sand forest; 15th Sept. 1932; flower. Field note—"*Resak peniau* or *resak durian*. Tree c. 25–30 m. high, 33 cm. diam. Flowers creamy white with strong, sweet, vanilla-like scent. Anthers bright yellow. Leaves hard and leathery, dark green above, light brown below. No buttresses. Bark stripping in thick longitudinal flakes".

Distribution.—Malay Peninsula, Sumatra, and Borneo.

Explanation of Plates

Plate 17. **Hopea Pierrei** Hance. 1, flowering twig. 2, sterile twig showing domatia on leaves. 3, flower bud (immature). 4,=3 with sepals removed. 5 & 6, outer sepals. 7, 8, & 9 inner sepals. 10 & 11, petal from flower bud. 12 & 13, stamens. 14, ovary & stylopodium. 15, section through 14. 16, ripe fruits. (Drawings of 1 & flower parts based on Pierre 1425; 2 on Foxw. 8; 16 on Guibier 2). *Scale applies to* 1, 2, & 16 *only*.

Plate 18. **Hopea Beccariana** Burck. 1, flowering twig. 2, branchlet of panicle with expanding flower & two buds. 3 & 4, outer sepals. 5, 6, & 7, inner sepals. 8 & 9, petal from mature flower. 10, 11, 12, & 13, stamens from mature flower. 14, flower with perianth parts removed to show ovary. 15, section through ovary. 16 & 17, immature fruits. 18 & 19, mature fruits. (Drawings of 1 & flower parts based on C.F. 9661 & 11673; 16 & 17, on C.F. 16574; 18 & 19 on S'p. 3474). *Scale applies to* 1, 16, 17, 18, & 19 *only*.

Plate 19. **Hopea pedicellata** (Brandis) Sym. 1, flowering twig. 2, branchlet of panicle with expanding flower & two buds. 3 & 4, outer sepals. 5, 6, & 7, inner sepals. 8 & 9, petal from mature flower. 10, 11, 12, & 13, stamens. 14, flower with perianth parts removed to show ovary. 15, section through ovary. 16, panicles with immature fruits. 17 & 18, mature fruits. (Drawings of 1 & flower parts based mainly on Curtis 167; 16 on C.F. 26913; 17 & 18 on S'p. 3474). *Scale applies to* 1, 16, 17, & 18 *only*.

Plate 20. **Shorea assamica** Dyer forma **globifera** (Ridl.) Sym. 1, flowering twig. 2, immature twig from sapling showing stipules. 3, branchlet of young inflorescence showing bracts. 4, flower bud. 5–9, sepals. 10 & 11, petal from mature bud. 12 & 13, stamens. 14, ovary. 15, 16, & 17, stigmas. 18, stigma partially disected. 19 & 20, fruits. (Drawings of 1 & flower parts based on C.F. 3072; 2 on C.F. 27226; 3 on C.F. 10369; 19 & 20 on 39071). *Scale applies to* 1, 2, 3, 19, & 20 *only*.

Plate 21. **Parashorea malaanonan** (Blanco) Merr. 1, flowering twig. 2, flower bud. 3, 4, & 5, outer sepals. 6 & 7, inner sepals. 8 & 9, petal from mature flower. 10, flower—sepals & petals removed. 11 & 12, stamens. 13, ovary. 14, end of the style showing stigma. 15, section through ovary. 16, immature fruit. 17 & 18, mature fruit. (Drawings of 1 & flower parts based on C.F. 39019; 16 on C.F. 30531; 17 & 18 on Elmer 21739). *Scale applies to* 1, 16, 17, & 18 *only*.

Plate 22. **Parashorea malaanonan** (Blanco) Merr. var. **tomentella** Sym. 1, flowering twig. 2, flower bud. 3, 4, & 5, outer sepals. 6 & 7, inner sepals. 8 & 9, petal from expanded flower. 10, flower—sepals & petal removed. 11 & 12, stamens. 13, flower—sepals, petals, & most stamens removed. 14, end of style & stigma. 15, section through ovary. 16 & 17, young fruits. 18=17 with sepals removed. (Drawings of 1 & flower parts based on C.F. 38745; 17 on C.F. 38845; 16 on C.F. 41064). *Scale applies to* 1, 16, 17, & 18 *only*.

Plate 23. **Shorea acuminatissima** Sym. 1, flowering twig. 2, flowering bud. 3, expanding flower. 4 to 8, sepals. 9 & 10, petal from mature flower. 11 & 12, stamens from flower bud. 13, 14, & 15,

mature stamens. 16, flower—perianth removed. 17, section through ovary. 18, immature fruit. 19 & 20, mature fruit. (Drawings of 1 & flower parts on C.F. 38723; fruit on C.F. 41075). *Scale applies to* 1, 18, 19, & 20 *only*.

Plate 24. **Shorea xanthophylla** Sym. 1, flowering twig. 2, mature inflorescence. 3, mature flower bud. 4, 3 with sepals & petals removed. 5 to 9, sepals. 10 & 11, petal from mature bud. 12 & 13, stamens. 14, section through ovary. 15, stigma. 16, fruit. 17, germinating fruit. (Drawings of 1 & flower parts based on C.F. 36776; 2 on C.F. 38742; fruits on For. Dept. Sarawak 277). *Scale applies to* 1, 2, 16, & 17 *only*.

Plate 25. **Shorea sandakanensis** Sym. 1, flowering twig. 2, flower bud. 3 to 7, sepals. 8 & 9, petals from bud. 10 & 11, petal from expanded flower. 12, ovary—sepals & petals removed. 13, 14, & 15, mature stamens. 16, section through ovary. 17, stigma. 15 & 19, mature fruit. (Drawings of 1 & flower parts based on C.F. 38730 & 38778; fruits on C.F. 41068). *Scale applies to* 1, 18, & 19 *only*.

Plate 26. **Shorea Smithiana** Sym. 1, flowering twig. 2, young inflorescence with bracts. 3, flower bud. 4, expanding flower. 5 to 9, sepals. 10 & 11, petal from mature flower bud. 12 & 13, stamens. 14, ovary—sepals & petals removed. 15, section through ovary. 16 & 17, fruits. (Drawings of flower parts based on C.F. 30472; fruits on C.F. 30524). *Scale applies to* 1, 2, 16, & 17 *only*.

Plate 27. **Vatica diospyroides** Sym. 1, flowering twig. 2, mature flower bud. 3 to 7, sepals. 8 & 9, petal from mature flower. 10, 11 & 12, stamens. 13, ovary—sepals & petals removed. 14, section through ovary. 15, stigma. 16 & 17, fruits. (Drawings of 1 based on Kerr 10011 & 18577; flower parts on Kerr 10011; fruits on Kerr 20546). *Scale applies to* 1, 16, & 17 *only*.

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A REDEFINITION OF THE GENUS TERATOPHYLLUM

By R. E. Holttum,
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When Kuhn published the original diagnosis of the genus Teratophyllum in 1869 he included in it the bipinnate species previously known as *Polybotrya articulata* J. Sm. and *Polybotrya Wilkesiana* Brack. These differ notably in several characters from the other species of the genus; so much so that when I prepared an account of Teratophyllum in 1932 (this Bulletin, vol. 5, pp. 277–304) I excluded them as possibly referable to a distinct genus. Copeland has included them in Lomagramma, but all known species of Lomagramma have characteristic features of spores and venation which are quite different from those of the two species in question (this Bulletin, Vol. 9, p. 194). I have now examined a number of specimens, and have come to the conclusion that the best treatment is to unite them to Teratophyllum as proposed by Kuhn. His diagnosis however omits a number of important points, and I have prepared a new one which includes what seem to me the essential features of the genus. The genus as so defined consists of two sections. The first and larger section comprises those species dealt with in my former paper; the second section has hitherto not received adequate description, and I give below as full an account of its species as the material at present available allows.

I am grateful to the authorities in charge of various herbaria for the loan of specimens, or for permission to examine specimens. The herbaria in question are cited as follows: Brisbane (Br.) British Museum (B.M.), Buitenzorg (B.), Kew (K.), Philippine National Herbarium (M.), Singapore (S.), U.S. National Herbarium (W.).

TERATOPHYLLUM Mett., emend. Holttum

Rhizoma paleis peltatis adpressis fugacibus squamosum, alte scandens, dorsiventrale, frondium duos vel plures ordines ferens. *Frondes* prope solum (bathyphylla) minores, multiformes; frondes superiores (acrophylla) majores, pinnatæ vel bipinnatæ. *Pinnæ* acrophyllorum omnes articulatæ pinnulæ articulatæ apicales exceptæ; venulæ pinnarum vel pinnularum sterilium liberæ, simplices vel furcatæ, ante marginem terminatæ, margines integræ vel serratæ, *pinnæ vel pinnulæ fertiles* plus minusve angustatæ, sæpe lineares, semper acrostichoideæ, nervatio earum plerumque venulis irregularibus supernumerariis sæpe anastomosantibus prope paginam inferiore aucta; *paraphyses* nullæ; *sporæ* perisporio vestitæ.

1. *Euteratophyllum.* Rhizoma tenue, frondes semper biseriatæ, acrophylla semper pinnata. Species typica: *Lomaria aculeata* Bl.

2. *Polyseriatæ*. Rhizoma adultum crassius, frondes polyseriatæ, acrophylla sterilia et fertilia sæpe bipinnata. Species typica: *Polybotrya articulata* J. Sm.

The section Euteratophyllum is confined, so far as at present known, to the Malaysian region, inclusive of the Philippines and New Guinea. The section Polyseriatæ does not occur west of Celebes, but extends into the Pacific as far as Tahiti, also northwards throughout the Philippines and southwards to Queensland.

Key to the section Polyseriatæ

Fertile pinnæ hardly more than 1 mm. broad *T. Brightiæ*

Fertile pinnæ much broader, or fertile fronds bipinnate
Sterile pinnules auricled on upper base *T. articulatum*
Sterile pinnules not auricled *T. Wilkesianum*

Teratophyllum articulatum (J. Sm.) Mett. Kuhn in Ann. Mus. Lugd. Bat. 4: 297. 1869.

Polybotrya articulata J. Sm. (nomen nudum) Journ. Bot. 3: 401. 1841.

Fêe, Hist. Acrost. 74, t. 37. 1845.

Lomagramma articulata Copel. Phil. Journ. Sci. 3C: 32. 1908.

Lomagramma bipinnata Copel. Phil. Journ. Sci. 11C: 114. 1916.

The type of this species is Cuming 296, from Leyte. I have seen specimens of this collection at Kew and from the U.S. National Herbarium. I have also examined the specimens listed below. I have not examined the type of Copeland's *Lomagramma bipinnata*, but from description it seems to fall well within the range of variation of the present species. The range of variation is considerable, and of the same character in widely separated countries. The essential features of the species may be summarised as follows.

Rhizome to 1 cm. diameter, longitudinally ridged, at first covered with small peltate lanceolate almost black scales with brown more or less fimbriate edges, smaller scales entirely brown.

Stipes to at least 25 cm. long; main rachis not winged, but 2-grooved above, scaly when young.

Fronds to about 80 cm. long and 30 cm. wide, with about 15 pairs of pinnæ; basal and apical pinnæ somewhat smaller than the rest.

Pinnæ to 20 cm. long and 3.5 cm. wide, with stalks up to 1 cm. long; pinnules about 20 pairs; pinna-rachis winged, the wing interrupted at the base of each pinnule and expanded into a narrow lamina at the apex of the pinna.

Sterile pinnules on short winged stalks about 1 mm. long, variable in size and shape, commonly about 18 mm. long and 7 mm. wide in the middle; upper base truncate, usually 7–8 mm. wide, forming a prominent auricle, sometimes a distinct basal lobe; lower base narrowly cuneate; both edges (except the base) obliquely toothed, the teeth not more than 1 mm. deep, one to each vein-ending; apex rounded or bluntly pointed; veins mostly forked, except the vein in the basal auricle or lobe which is pinnate; surfaces of fully expanded frond naked except for a few scales on the lower surface, mostly on the midrib, the larger scales sac-shaped.

Fertile pinnules on winged stalks 2 mm. long, about 4–7 mm. long and 1 mm. wide when dry, the upper base distinctly auricled, the apex rounded.

Young stages. One specimen examined shows the young stage of the plant, namely Clemens 1018 from Mindanao. The rhizome is very slender and has simply pinnate fronds to about 12 cm. long and 2.5 cm. wide; the fronds each have about 10 pairs of pinnæ and an apex consisting of a narrow lamina continuous with the rachis. The stipes are not more than 1 cm. long, and in all cases there are one or two basal unpaired pinnæ on the side of the rachis towards the base of the plant, the side of the rachis towards the apex of the plant being devoid of pinnæ (this is in agreement with some species of Euteratophyllum). The pinnæ are up to 12 mm. long and 7 mm. wide, the general shape like the pinnules of the acrophylls but the veins fewer and the teeth larger and rounded. The lower surfaces bear sac-shaped scales like those of the acrophylls.

This specimen evidently represents a young stage, and we have no definite information as to whether the fronds on it are normal bathyphylls, or whether such may be bipinnate on larger rhizomes. The resemblance to *T. aculeatum* is striking, but the shape of the pinnæ and the scales are characteristic of *T. articulatum*, and there can be no doubt that reference to the present species is correct.

A specimen from Celebes (part of Bünnemeijer 11138) may perhaps represent more normal bathyphylls. The fronds are small, bearing pinnules of hardly more than half the usual size, and are attached to a slender rhizome. In the same collection are fronds of normal size with larger pinnules.

Distribution: from Celebes and the Philippines through New Guinea to the Solomon Islands.

PHILIPPINES. *Leyte:* Cuming 296 (type collection, K., W.); Dagami, C. A. Wenzel 89 (M.). *Luzon:* Mt. Masingit, Lubuagan, Kalinga Subprov., Bur. Sci. 37500, Ramos and Edano (M., B.); Caraballo Mt., Nueva Vizcaya Prov., Bur. Sci. 13730, 13733, 13716, Loher (M.). *Mindanao:* Camp Keithley, Lake Lanao, M. S. Clemens 1073 (M.), 1018 (M.), s.n. (B.).

CELEBES. Lombasang, N. W. Celebes, Bünnemeijer 11138 (B.). Papepekang, Bonthain, Teysmann 13688 (B.). Mt. Bonthain, S. W. slope, 1500 m., Posthumus 2720 (S.). Prov. Minahassa, Koorders 17073 (B.), 17056 (B.), 17032 (B.).

CERAM. 1000–1400 m., Rutten 2213 (B.).

NEW GUINEA. Nassau Geb. 700 m., Docters van Leeuwen 10680 (B.). Boridi, Papua, 4,800 ft. Carr. 14212 (S.). K. Wilhelmsland, Wapao, 600 m., Bamler (Rosenstock, Fil. Novoguin. 122, M.).

SOLOMON ISLANDS. Bougainville, 1600 m., Kajewski 1711 (M.), 1200 m., Kajewski 2669 (M.).

Teratophyllum Brightiæ (F. von. Muell.) Holttum comb. nov. **Plate 28.**

Acrostichum Brightiæ F. von Mueller, Fragmenta 7 : 119. 1870.

The original description of this species is as follows :—

Alte scandens, frondibus simpliciter pinnatis, rachi aptera, *pinnis cum rachi articulatis, sterilibus fere conformibus membraneis perangusto-vel falcato-lanceolatis conspicue petiolulatis ad basim fere cuneatam inæquilateris* tenui-acuminatis irregulariter repando-crenulatis subtus pallide virentibus, venis tenuibus multis inferme longiuscule simplicibus superne dicladis, *apicibus venarum fere clavato-incrassatis ante marginem evanescentibus,* rachi frondis fertilis squamulis angustis acutis crispulis conspersa, pinnis anguste linearibus remotiusculis.

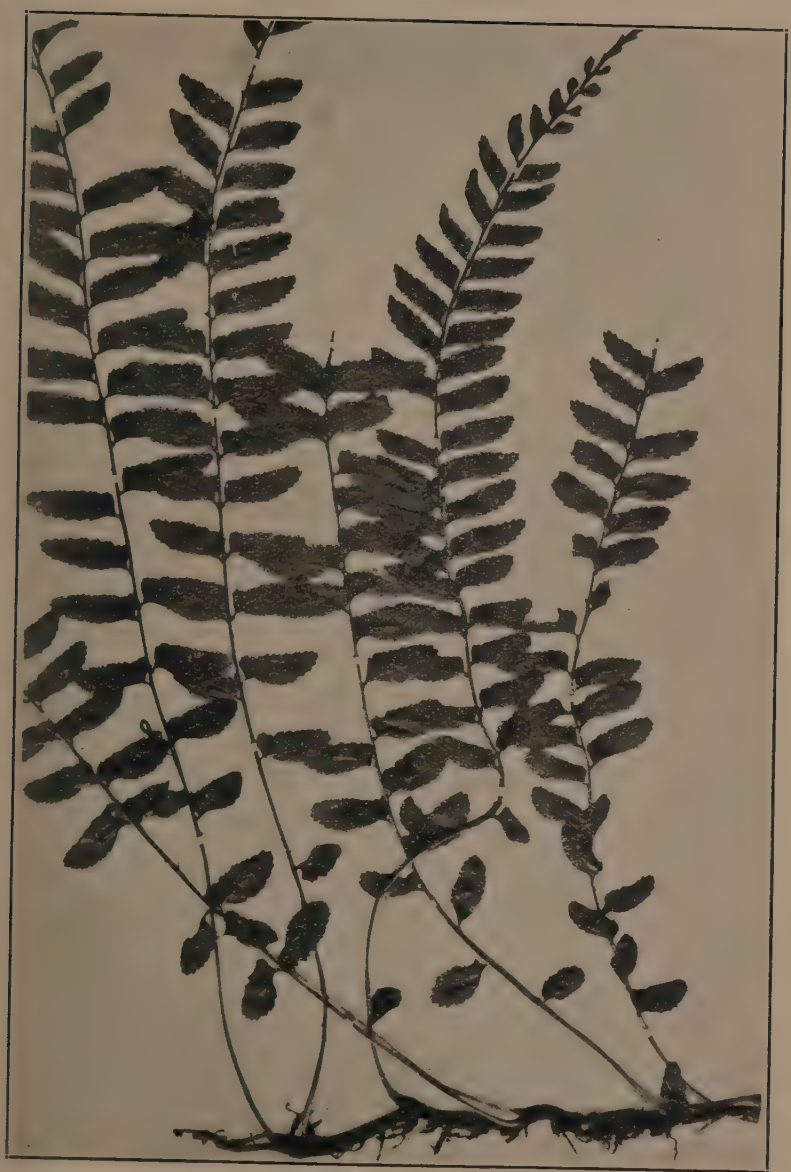
In monte Grahami prope Rockingham's Bay; J. Dallachy.

Caudex ad altitudinem 20′ scandens, angulosus, superne semi-pollicem crassus. Rachis frondis sterilis fere nuda. Pinnæ steriles 3–5″ longæ, 4–7‴ latæ; fertiles vix semilinea latiores. Sporangia flavida.

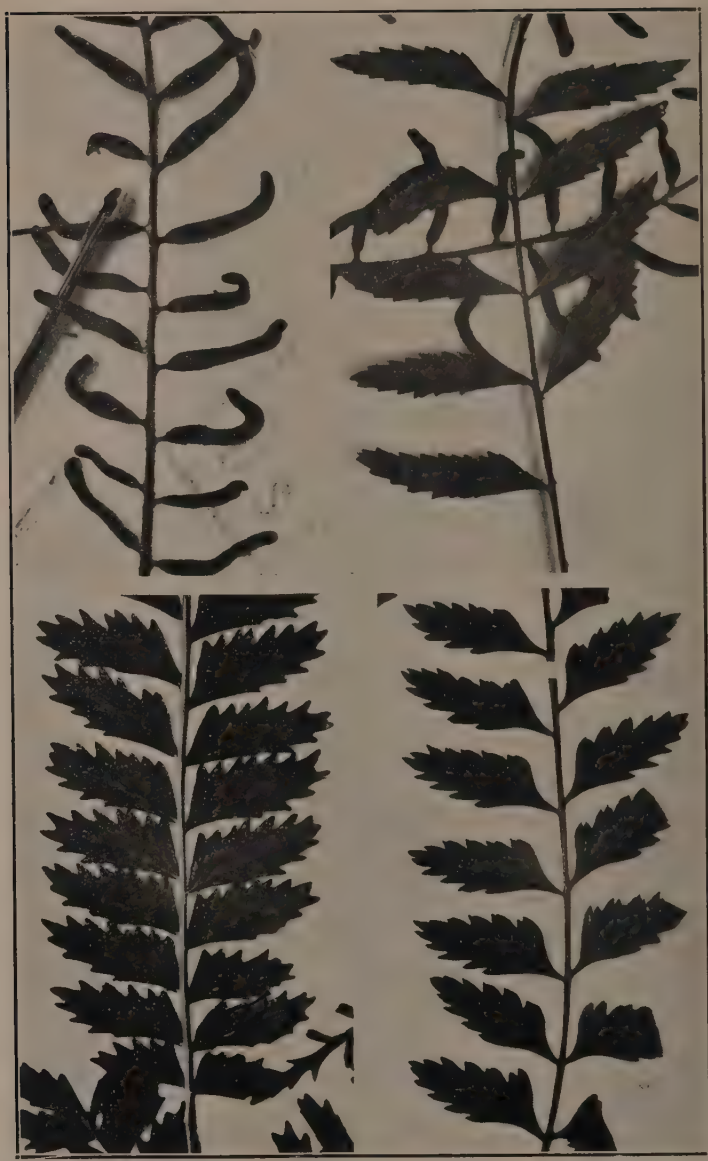
By the courtesy of Mr. C. T. White, I have examined a number of specimens from the Queensland Herbarium (Brisbane), and can add the following particulars to von Mueller's description.

Rhizome. The acrophyll-bearing rhizome may have at least four leaf-gaps. The bathyphyll-bearing rhizome has usually two leaf-gaps as in Eu-teratophyllum. One specimen shows a stout old rhizome bearing bathyphylls on young lateral branches; apparently this rhizome had fallen and was starting new growth again from its fallen position.

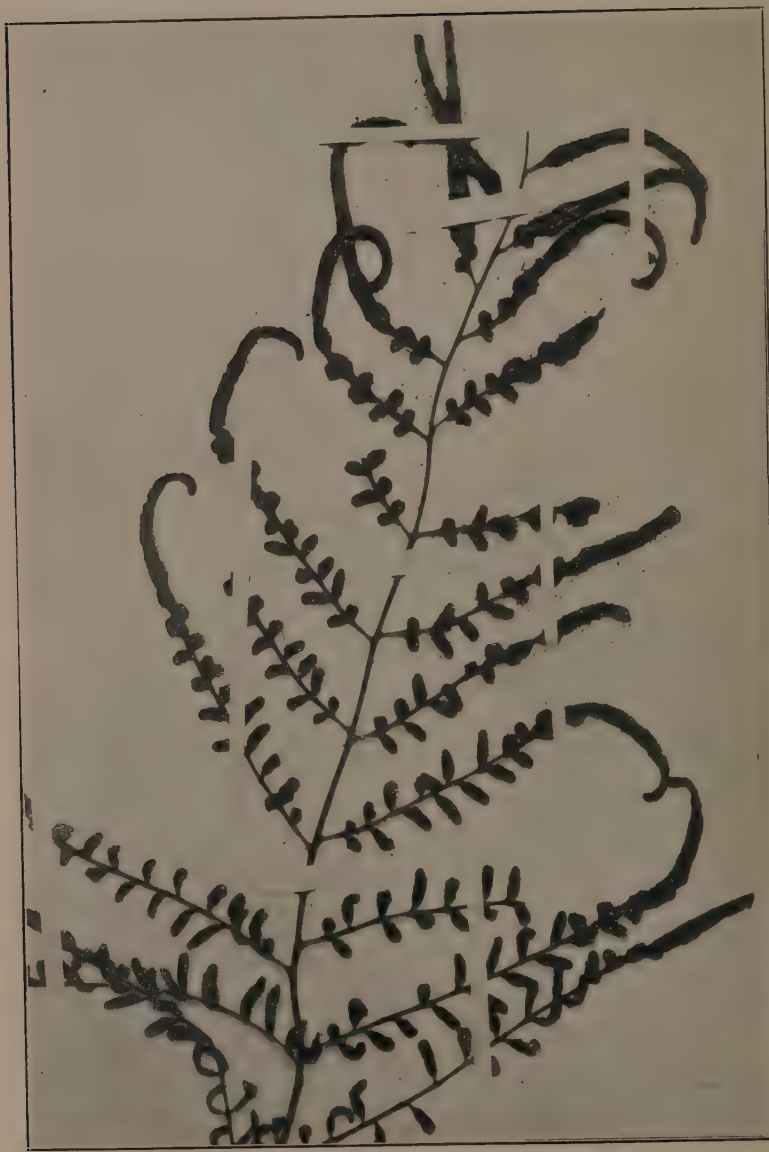
Bathyphylls. These are fully represented in the Brisbane collections. They vary a good deal in size, the largest approaching the smallest acrophylls in size of pinnæ. They differ constantly from the acrophylls in (1) the apex of the frond, which consists of a narrow toothed lamina, its midrib continuous with the rachis, and (2) the broadly truncate or even subauriculate upper base of the pinnæ. The smaller bathyphylls show a decided resemblance to the young stage of *T. articulatum* described above, or to pinnæ of acrophylls of *T. articulatum.*



Teratophyllum Brightiæ. Bathyphylls, ¾ nat. size. Eumundi, Shirley, U.S. National Herbarium.



Teratophyllum Wilkesianum. Above, Type specimen (fertile and sterile). Below, specimen from New Caledonia on left, from Tahiti on right (Setchell & Parks 294). All about x 1.5.



Teratophyllum Wilkesianum. Fertile frond showing condition intermediate between pinnate and bipinnate. Tahiti, Vesco, Manila Herbarium. ¾ nat. size.

The stipes vary in length, but are commonly 3 to 5 cm. long. The pinnæ are about 20 pairs, the lowest one or two usually unpaired. The middle pinnæ have winged stalks 1–2 mm. long, the upper base broadly truncate, the lower narrowly cuneate, the edge obliquely toothed, one vein-ending to each tooth, the apex rounded in the lower pinnæ, more or less acute in the upper ones, veins mostly forked (the lowest on the acroscopic side often twice forked); size of middle pinnæ of average bathyphylls about 2 cm. long by 5 mm wide. The rachis is winged almost throughout, the wing produced to a tooth below each pinna.

Sterile Acrophylls. All pinnæ are articulate; the pinna stalks 2–3 mm. long; the upper base sometimes very broadly cuneate, approaching the bathyphyll condition; the apex rather suddenly narrowed to a toothed subcaudate tip; the margins toothed very much as in simply pinnate specimens of *T. Wilkesianum* from New Caledonia and Samoa.

Fertile acrophylls. Pinna-stalks to 5 mm. long, pinnæ to 14 cm. long, usually not more than 1 mm. wide when dry; one specimen has pinnæ almost 2 mm. wide.

Distribution: Queensland, extending southwards just beyond the tropic.

Specimens examined. Eumundi, Bailey and Simmonds 1894 (several specimens, Br.), J. Shirley (W.). Palm Island, F. L. Bancroft (Br.). Herberton, F. M. Bailey (Br.). Between Herberton and Cairns, C. J. Wild 1891 (Br.). Range Trinity Bay, F. M. Bailey (Br.). Atherton Tableland, W. D. Francis, May 1928 (Br.). Scrub, Cairns District, Watts, July 1913 (Br.). Johnstone River, W. A. Kefford (Br.). Covering the branches of trees, below Bon Accord Falls, Blackall Range, C. T. White, Ap. 1918 (Br.).

Teratophyllum Wilkesianum (Brack.) Holttum comb. nov. **Plates 29, 30.**

Polybotrya Wilkesiana Brack. in Wilkes, U.S. Expl. Exped. 16: 80, pl. 10. 1884.

Lomagramma Wilkesiana Copel. Phil. Journ. Sci. 3C: 32. 1908. Maxon, Univ. Cal. Publ. Bot. 12: 28, pls. 3, 4. 1924.

The type of this species is in the U.S. National Herbarium, and has been kindly lent to me for inspection. It differs rather strikingly from all other specimens I have seen from Tahiti and from New Caledonia, so that it seems to me desirable to give a description first of the type only, and then to add some notes on the points in which other specimens differ. It is clear that Tahiti ferns which are referred to this species are very polymorphic, and more field study will be needed before we can understand them at all adequately. For the present I retain all under this species.

The chief characters of Wilkes' specimen are as follows.

Rhizome 1 cm. diameter, vascular cylinder with 8 leaf-gaps. *Stipe* 20 cm. long, stramineous, grooved on adaxial side, naked except for minute scattered dark narrow peltate scales. *Rachis* stramineous, when young scaly above with very narrow pale scales, naked when old, 2-grooved on the adaxial side, not winged but the outer margins of the grooves shortly papillate at the base of each pinna.

Pinnæ apparently about 12 pairs (rachis broken), all articulate to rachis, uppermost somewhat smaller than rest. *Sterile pinnæ* to at least 15 cm. long and 3.5 cm. wide, pinnate, lowest pinnules 8–15 mm. from main rachis; pinnules to about 18-jugate, about 7–9 mm. apart; pinna rachis distinctly winged, the wing broken and prolonged into an auricle at the base of each pinnule.

Sterile pinnules sessile or with a very short winged stalk, to 20 mm. long and 5 mm. wide, the base narrowly unequally cuneate, the apex falcate acute, the margins with oblique teeth about 1 mm. deep; veins 6–8 pairs, those on the acroscopic side all forked, on basiscopic side some at least simple, each vein ending close to the apex of a tooth; texture thin but firm; colour dark above, paler beneath; surfaces naked except for a few minute scales; the distal pinnules gradually reduced and adnate, merging into the apex of the pinna.

Fertile pinnules to about 18-jugate, distinctly stalked (stalks about 1 mm. long), 15–20 mm. long and hardly more than 1 mm. wide when dried, the base almost equally cuneate, the apex rounded. The venation of the fertile pinnules shows a very remarkable additional vascular supply to the sporangia, consisting of two rows of closed areoles, almost completely superseding the normal venation. There are indications of this in other fertile fronds, notably Franc 662 from New Caledonia, but in none that I have examined is the additional vascular system anything like so fully developed.

The other specimens differ from the type in the following points.

The *sterile pinnules* are usually a little shorter and wider, the upper base more broadly cuneate and the apex less falcate and less acute. The upper base is especially broad, almost truncate, in some specimens from New Caledonia, and in these the first vein is twice forked, approaching the condition found in *T. articulatum*. The marginal teeth are usually closer than in the type, but not appreciably deeper, except in some specimens which appear to be from young plants, or are perhaps bathyphylls; in these (both from Tahiti and New Caledonia, but especially the latter) the margins are deeply incised between the main lateral veins.

The *fertile pinnules* are always unequally cuneate at the base, sometimes pronouncedly so, and nearly all are shorter than the type, some barely 5 mm. long. The largest fertile pinnules I have seen on any specimen except the type are on Franc 662

from New Caledonia (specimen at Büitenzorg), on which they are as much as 15 mm. long.

Simply pinnate fronds occur on some specimens, from both Tahiti and New Caledonia (also Samoa), both sterile and fertile. Maxon, l. c., discusses these fronds and gives references to former literature. There can be no doubt that both bipinnate and pinnate fronds occur on the same plant. Setchell and Parks collected a frond showing an intermediate condition (their no. 512, figured by Maxon), and there is a specimen in the Manila herbarium (Vesco 1847) showing a similar intermediate condition in a fertile frond. It seems that the pinnate condition is sometimes but not always attained by plants of this species, and that the bipinnate condition is more usual. Setchell and Parks report the two as associated together. It is evident that the bipinnate fronds are not merely bathyphylls, as Setchell and Parks record them on a plant climbing high trees; and also there are bipinnate fertile fronds. It is probably significant however that there are no small pinnate fronds, and it is likely that this form is only developed on high climbing stems.

Pinnate sterile fronds. Pinnæ about 12-jugate, stalked, stalks of lower pinnæ to about 7 mm. long. Pinnæ of Setchell and Parks 512 to about 10 cm. long and 2 cm. wide, base unequally cuneate (broader in lower pinnæ than in upper), gradually narrowed from widest part just above base to near apex, apex rather suddenly narrowed to a linear portion about 1 cm. long, edges irregularly toothed, teeth short and not acute, one to each vein-ending, the margins slightly cartilaginous and reflexed; veins close, oblique, usually once forked. Pinnæ of simply pinnate fronds from Samoa and New Caledonia to 15 cm. long, the bases on the whole more broadly cuneate (especially in the upper pinnæ) and the edges rather more deeply toothed.

Pinnate fertile fronds. Pinna stalks to 7 mm. long; pinnæ to 10 cm. long and 5 mm. wide, base unequally cuneate, venation as in sterile pinnæ.

As above noted, the specimens from New Caledonia differ in some points from Tahiti specimens, but I do not think that the differences are clear enough to warrant the description of a new species. It is very remarkable that though specimens have been collected in Samoa, none have been reported from Fiji, which is nearer to New Caledonia. The Samoa specimens appear to be nearer to those of New Caledonia than to those of Fiji.

TAHITI. U.S. South Pacific Exploring Exp., Wilkes (Type, W.). Setchell and Parks 211 (W.), 294 (W.), 296 (B., S., W.), 315 (W.), 512 (W.). Grant 4459 (B., W.). M. Vesco s.n. 1847, dist. Paris (M.). N. J. Andersson s.n. 1852, dist. Stockholm (W.).

NEW CALEDONIA. Franc 662, herb. Bonati (B., W.). Rosenst. Fil. Nov. Cal. exsic. 16, leg. Franc (M., W.) and 113,

leg. Franc (W.). Cribs s.n. 1901, dist. Paris (M.). Richards s.n. 1863, dist. Sydney (W.).

SAMOA. West Savaii, Reinecke 87*b* (B., W.).

Doubtful Species

Lomariopsis Balansæ Fourn. Ann. Sci. Nat. V. 18: 271. 1873.

This is described as a simply pinnate species, and there is nothing in the original description which gives any definite information as to which of the genera Lomariopsis or Teratophyllum is concerned. There is however a specimen at Kew (Franc 663, Herb. Bonati) which was determined by Christ as *L. Balansæ;* this is very close to *Teratophyllum Wilkesianum,* and apart from shorter stalks of the pinnæ I could not see any definite distinction. The spores have a finely granular perispore. In the absence of further information this must be regarded as a doubtful species. Examination of the type to see whether or not the terminal pinna is articulated would at least decide the genus.

Discussion on the Polyseriatæ

As indicated in the diagnosis, the species of this section of the genus agree together in having the fronds on the climbing rhizome polyseriate, not biseriate as in Euteratophyllum. It is probable also that they have certain distinctive points in common as regards their bathyphylls, but the information at present available is incomplete. There appear to be no other constant features in which all of them differ from Euteratophyllum. The bipinnate acrophylls of *T. articulatum* and *T. Wilkesianum* are certainly different from anything in Euteratophyllum, but the simply pinnate acrophylls of *T. Wilkesianum* and *T. Brightiæ,* if parted from their rhizome, could not be distinguished from Euteratophyllum. *T. Brightiæ,* with its complete lack of all bipinnate fronds, is closely similar to Euteratophyllum except in its bathyphylls.

The bathyphylls of *T. Brightiæ* (and probably also those of *T. articulatum,* judging from a very young stage) differ from those of all species of Euteratophyllum in having distinct stipes free of pinnæ; all Euteratophylla have the lowest bathyphyll pinna right against the rhizome and reflexed to overlap the rhizome. Most Euteratophylla also have much more deeply dissected bathyphyll pinnæ, though a few are simply pinnate.

As regards the general question of the relationship of Teratophyllum to other fern genera, I cannot give any opinion beyond the suggestions made in my former paper. It seems probable that Teratophyllum and Lomariopsis are closely related, but Teratophyllum is a much more specialised genus in many ways, with a more restricted distribution. I think that they have probably had independent origins in a group of acrostichoid ferns with short-creeping rhizomes; possibly from Bolbitis.

PUBLICATIONS OF THE BOTANIC GARDENS, SINGAPORE

1. **The Agricultural Bulletin of the Malay Peninsula** [Old Series] nos. 1–9, 1891–1900 (out of print).

2. **The Agricultural Bulletin of the Straits and F.M.S.** [Second Series, monthly issues] Vols. 1–10, 1901–1911. Most numbers are available, price 50 cents each or $5 per volume.

3. **The Gardens Bulletin, Straits Settlements.**

   Vol. 1 nos. 1–5, January to May 1912 (as *Agricultural Bulletin of the Straits and F.M.S., Third Series*). nos. 6–12, December 1913—March 1917 (as *The Gardens Bulletin, S.S.*).

   Vol. 2 nos. 1–12, July 1918—August 1921.

   Vol. 3 nos. 1–12, August 1923—March 1925.

   Vol. 4 nos. 1–12, June 1926—January 1929.

   Vol. 5 nos. 1–12, August 1929—June 1932.

   Vol. 6 nos. 1–15, (issued as parts 1–3) December 1929—October 1930.

   Vol. 7 parts 1–3, September 1932—June 1934.

   Vol. 8 parts 1–4, October 1934—October 1935.

The above former issues of the Gardens Bulletin may be purchased from the Botanic Gardens, Singapore, at $5 per volume or 50 cents per number for vols. 1–5 (Vol. 6, of 15 numbers, $7.50); in some cases two or more numbers were published together. Vols. 7 and 8 are published at $8 per volume; the prices of parts vary according to their size. The parts are published at irregular intervals, as material is available.

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